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UNITED KINGDOM

Selected Issues

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Approved by European I Department

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United Kingdom: Basic Data

Demographic and other data:

Area	94,247 square miles (244,100 sq. km.)
Population (mid-2001)	59.5 million
Infant mortality (per 1,000 live births)	6.1
Doctors per 1,000 inhabitants	0.5
GDP per capita (2000)	SDR 18,360

Composition of GDP in 2000, at current prices	In billions of Pounds	Distribution in Percent
Private consumption	611.7	62.9
Public consumption	174.2	17.9
Total investment (including stockbuilding)	161.8	16.6
Total domestic demand	953.19	98.0
Exports of goods and services	254.3	26.2
Imports of goods and services	272.2	28.0
GDP at market prices (average estimate)	972.6	100

Selected economic data	1999	2000	2001	
Output and unemployment:	(Annual percentage change)			
Real GDP (at market prices, average estimate)	2.3	2.9	2.3	1/
Manufacturing production	0.8	0.3	0.6	1/
Average unemployment (in percent)	6.0	5.6	5.1	1/
Earnings and prices:				
Average earnings in manufacturing	4.1	4.6	4.8	1/
Retail price index, excluding mortgage interest	2.2	2.1	2.4	1/
Money and interest rates:				
M0 (end of period)	11.7	4.8	6.3	2/
M4 (end of period)	4.2	8.3	8.1	2/
3-month Interbank rate	5.4	6.1	4.0	3/
10-year government bond yield	5.6	4.9	4.9	3/
	(In billions of pounds sterling)			
Fiscal accounts (In percent of GDP): 5/				
General government balance	1.9	2.7	-1.3	4/
Public sector balance	1.8	4.3 6/	-1.1	4/
Public sector net debt	38.2	32.7	30.8	4/
Balance of payments:				
Current account balance	-19.1	-17.0	-20.3	1/
(In percent of GDP)	-2.1	-1.8	-0.8	1/
Trade balance	-26.2	-28.8	-34.0	
Exports	166.2	187.7	191.0	
Imports	-193.7	-218.0	-225.0	
Direct investment (net)	-76.0	-78.9	-77.5	6/
Portfolio investment (net)	104.5	89.1	96.8	6/
Gross reserves, official basis	22.2	28.3	26.4	2/

Source: National Statistics; HM Treasury; and IMF staff estimates.
HM Treasury and staff estimates.

1/ As of 3rd quarter 2001.
2/ November 2001.
3/ December 2001.
4/ Includes 2.4 percentage points of GDP in 2000/01 corresponding to the auction proceeds of spectrum licenses.
5/ Fiscal year beginning April 1.
6/ Includes 2.4 percentage points of GDP in 2000/01 corresponding to the auction proceeds of spectrum licenses.
7/ January-June 2001.

I. The Macroeconomic Effects of U.K. Fiscal Policies: An Empirical Exploration[1]

A. Introduction and Overview

1. This paper studies from an empirical standpoint the impact of fiscal aggregates on the evolution of output and the real effective exchange rate (REER) in the United Kingdom during the period from the late 1970s to the present. It finds, first, that the size of the dynamic fiscal multipliers is small, and often statistically nonsignificant. Second, that the direction of the impact of taxes and government consumption, but not of social transfers, is, if anything, the reverse of that predicted by standard Keynesian models.[2] For example, an increase in government consumption tends to depreciate the REER and slightly depress output. And third, that these unconventional effects of fiscal policy appear to result from the behavior of private domestic agents, who, on balance, tend to react to fiscal expansions by contracting consumption and investment (and vice versa). These results are consistent with a growing body of empirical studies, including those on expansionary fiscal contractions and on the Ricardian equivalence hypothesis. This paper, however, remains largely agnostic as to the factors underlying the non-Keynesian effects of budgetary policies, on which a consensus is yet to emerge.

2. The results, however, do not directly imply that fiscal policy has little or no effects on output and the exchange rate in all circumstances. The estimates of the fiscal multipliers reflect an extended period of time and it is possible, as argued below, that the effects of fiscal policy might be nonlinear, with different—and even opposite—effects depending on expectations of future policies and private sector confidence. Thus, for example, during 2001, private consumption did not slow down in response to the increase in government spending as the multipliers—estimated for the whole sample period—would predict. This could be, for instance, because the current budgeted impulse is not seen as threatening the state of the public finances or because interest rates have not risen—indeed have been cut significantly.

3. The study of the effects of fiscal policy on economic activity, including through the exchange rate, is a classic theme in macroeconomics and has been extensively discussed in

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[1] Prepared by Julio Escolano. The author acknowledges the insightful suggestions and contributions from the mission team and from HM Treasury and Bank of England participants in a seminar held during the mission's visit to London.

[2] As has become standard—perhaps unfortunately—in the related literature, the term "Keynesian" is used loosely in this paper to indicate a significant positive effect of government expenditure, or tax cuts, on output. Nevertheless, as discussed later, a small estimated size of fiscal multipliers is not necessarily inconsistent with standard Keynesian theory.

the literature.[3] Nevertheless, until recently, most of the work in this area had discussed the effects of fiscal policy from a theoretical angle and attempts to quantify empirically these effects had been typically based on simulations of large-scale macroeconomic models.[4] As indicated in Blanchard and Perotti (1999), however, these simulations tend to postulate, more than explore empirically these effects. In particular, simulation methodologies are not well suited to capture the existence of confidence effects and nonlinearities in the transmission mechanism of fiscal policy, even if they were present, as the underlying macroeconometric models used for the simulations tend to assume them away.[5]

4. During the 1990s, research evaluating the existence of non-Keynesian effects of fiscal policy has gained significant impetus, generated in part by prominent episodes of fiscal consolidations that were associated with sustained expansions of output—such as, for example, in Denmark (1983–86), Ireland (1987–89), and Sweden (1983–89)—as well as from converse experiences—such as Sweden in the early 1990s and Japan in the 1990s.[6] This research has also been propitiated by the increasing availability of national statistics relatively comparable across countries and the development of adequate econometrical instruments for dealing with dynamic effects—notably structural vector autoregression (VAR) techniques.

5. Without attempting here a review of this recent strand of the literature, it is worth mentioning some contributions that are relevant to this paper. Since Giavazzi and Pagano (1990), an increasing number of studies have identified instances of non-Keynesian effects of fiscal policy, particularly fiscal consolidations that had an expansionary effect.[7] Although the

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[3] A recent and comprehensive review of the literature and existing evidence covering both theoretical and empirical aspects can be found in Hemming, Kell, and Mahfouz (2000). For a discussion of the long-run impact of fiscal policy on growth see Tanzi and Zee (1997).

[4] Hemming, Kell, and Mahfouz (2000) contains a summary of results across the literature from estimates of fiscal multipliers based on macroeconomic model simulations, including estimates based on the OECD's INTERLINK model for G-7 countries. European Commission (2001) reports fiscal multipliers based on QUEST simulations for countries in the EU.

[5] Perotti (2000) discusses results from simulating the effects of fiscal policy with macroeconometric models. See also Blanchard (2000).

[6] Analyses of expansionary fiscal contractions and contractionary fiscal expansions based on case studies include, among others, Giavazzi and Pagano (1990), Giavazzi and Pagano (1996), Alesina and Perotti (1997), and Alesina and Ardagna (1998).

[7] The search for non-Keynesian effects of fiscal policy focused initially on OECD countries. For example, Giavazzi and Pagano (1990) studies the cases of Denmark and Ireland, and Giavazzi and Pagano (1996) extends the search to 19 OECD countries while focusing on Sweden. Giavazzi, Jappelli, and Pagano (2000) extended the analysis to developing countries

(continued)

literature is far from unanimous regarding the underlying causes of these unconventional effects, researchers have attempted to describe and typify sets of circumstances that appear associated to them.[8]

6. First, the literature stresses the role of forward-looking expectations of agents and confidence effects in the possible existence of nonlinearities in the transmission channels of fiscal policy. The hypothesis is that, while small policy shocks may have the conventional Keynesian effect, large and persistent policy changes that force an overall reassessment of agents' expectations may give rise to expansionary fiscal contractions and contractionary fiscal expansions, as the case may be. Thus, Giavazzi, Jappelli, and Pagano (2000) find that, in OECD countries, non-Keynesian effects of fiscal policies tend to be associated with large and persistent fiscal impulses, although the level and dynamics of public debt do not always appear significant. In contrast, they find in a large sample of developing countries that non-Keynesian effects tend to be associated with rapidly changing public debt levels, while the size of the fiscal consolidation as such is less significant. They conjecture that the capacity to service public debt and the possibility of a default is less of an immediate concern in OECD countries, while it is a more relevant source of uncertainty in developing countries. In a similar vein, Baldacci, Cangiano, Mahfouz, and Schimmelpfenning (2001) finds in a wide sample of countries that favorable initial fiscal and external conditions tend to support fiscal policy having the conventional Keynesian effects. Alesina and Perotti (1997), Alesina and Ardagna (1998), and Perotti (1999), inter alia, also find evidence of nonlinear effects of fiscal policy. In virtually all cases, when the fiscal multipliers are estimated through methodologies that do not entail strong a priori assumptions on the transmission mechanism (i.e., through reduced-form specifications), the size of the multipliers turns out significantly smaller than suggested by simulations of structural macroeconometric models. Thus, with a methodology similar to this paper, Blanchard and Perotti (1999) find that the fiscal multipliers for the United States have the standard Keynesian signs but their size is smaller than suggested by earlier estimates.

7. The findings of this paper are consistent with this view. Although our sample period (1979Q1–2001Q3) was primarily determined by the availability of suitable data, the period is dominated by two large and sustained fiscal consolidations (1976–1988, and 1994–2000, see Figure 1) that started from high fiscal deficits and were accompanied by an equally sustained

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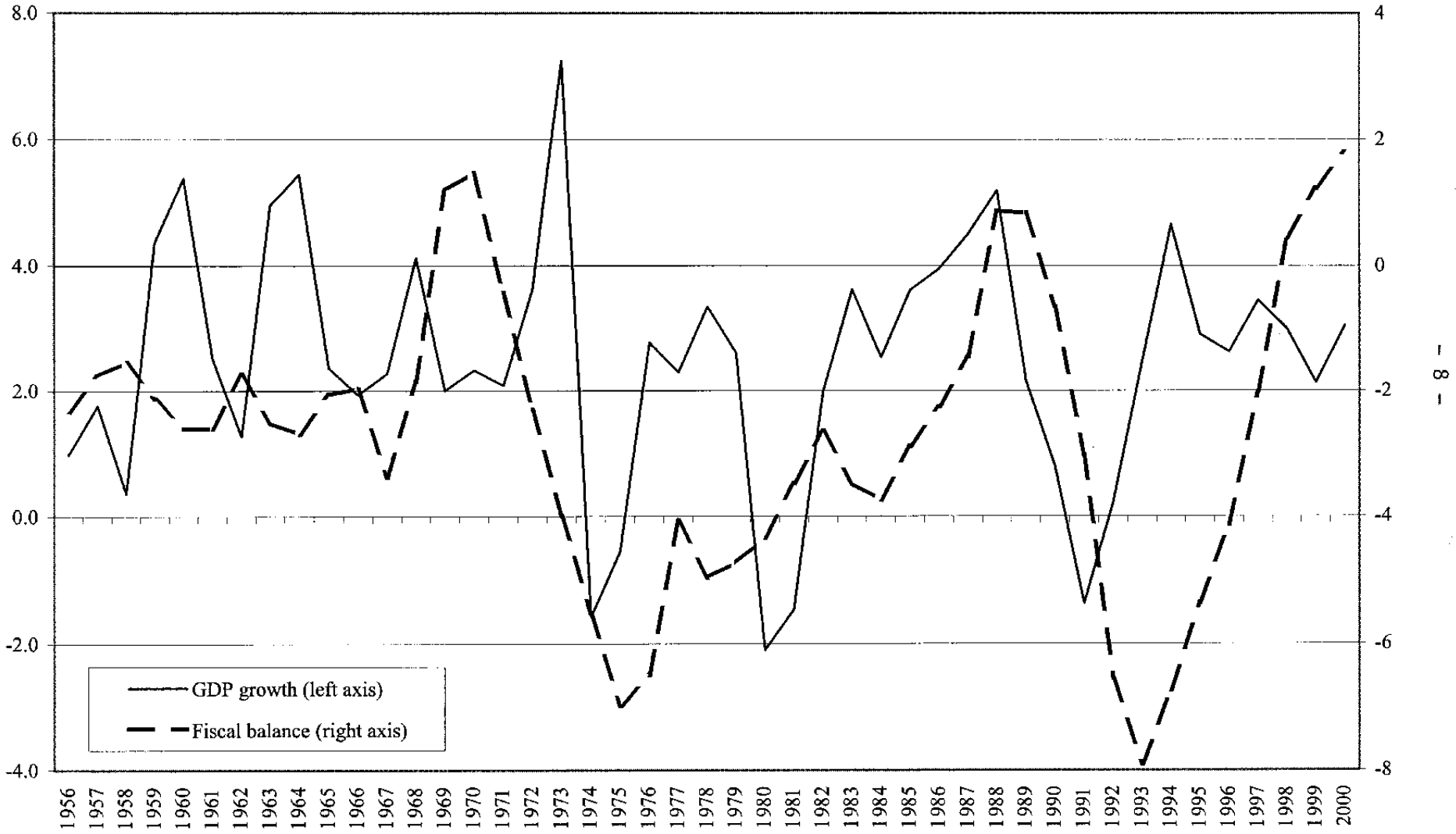
using the World Bank dataset. Baldacci, Cangiano, Mahfouz, and Schimmelpfenning (2001) is also based on a comprehensive country set, including transition, emerging, and developing economies. Hemming, Mahfouz, and Schimmelpfenning (2002) also finds some instances of non-Keynesian effects of fiscal policy during recessions.

[8] Bertola and Drazen (1993), Sutherland (1996), and Perotti (1999 and 2000) suggest theoretical underpinnings for non-Keynesian effects of fiscal policy.

Figure 1. UK: Output Growth and Fiscal Balance
(In percent and percent of GDP)



demand-driven recovery in growth.[9] Estimates of the dynamic fiscal multipliers for the period 1963–78 (with a restricted set of variables that exclude the REER) have the conventional Keynesian signs, with the exception of the multiplier of government consumption, which remains close to zero and statistically nonsignificant.

8. A second conclusion in the literature is that the composition of budgetary policies matters. Drawing on the experience of twenty OECD countries, Alesina and Perotti (1995 and 1997) show that permanent improvements in the public finances are typically driven by spending cuts, whereas fiscal consolidations based on tax increases tend to be temporary. Political economy argues also in this direction: even if private demand were equally responsive ex ante to revenue and expenditure measures, the former would have a larger effect in shaping expectations of a successful fiscal adjustment—including because, being politically costlier, spending cuts would signal a government's determination in consolidating the public finances.

9. Prompted by these arguments, the empirical analysis conducted here avoids the use of a single indicator of the fiscal policy stance (such as the fiscal deficit) and considers separately the effects of government consumption, social transfers, and tax revenue. We find that the dynamic multipliers associated to government consumption, social transfers, and taxes are indeed different in size and lag profile. The estimated multipliers on output of government consumption and taxes are very close to zero and statistically nonsignificant (but still with the reverse sign than predicted by Keynesian theory). By contrast, the estimated multiplier on output associated with spending on social transfers has the conventional sign: positive shocks to spending result in an expansion of output, mainly during the subsequent four quarters. The multipliers of all fiscal variables on the REER are statistically nonsignificant.[10]

10. The methodology used in this paper owes much to Blanchard and Perotti (1999). As in that paper, we use a structural vector autoregression (VAR) methodology. Once the VAR is estimated and the contemporaneous coefficients are identified, the impulse response functions of the (logarithms of) budgetary aggregates on (the logarithm of) output and the REER can be interpreted as the dynamic multipliers of the budgetary variables. To our knowledge, no such study has been carried out for the U.K. economy, although this or similar methodologies have been extensively used to analyze the effects of monetary policy in the United Kingdom and elsewhere and of fiscal policy in the United States and other countries. The next section describes the methodology in detail and the following section discusses the main findings and extensions of the basic model. Finally, we offer some conclusions.

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[9] The output expansion during 1976–1989 was interrupted by two years of negative growth in 1980–1981.

[10] The width of confidence intervals throughout this paper is set to two standard deviations, which under normality assumptions implies roughly 5 percent confidence.

B. Methodology

11. The basic reduced-form specification of the VAR analyzed here is

$$y_t = \beta x_t + \sum_{i=1}^{l} \mathbf{H}_i y_{t-i} + u_t \qquad (1)$$

where y_t is the vector of the state variables, and x_t are the exogenous variables, including a constant, a deterministic quadratic time trend, and dummy variables. The vector u_t are the reduced-form non-orthogonal disturbances with covariance matrix Σ and l is the maximum lag. The matrices β, $\mathbf{H}_i$, and Σ are 5×5 matrices of parameters to be estimated. The state variables of the basic model included in y_t are the logarithms of government consumption, tax revenue, social transfers, GDP—all in real terms, seasonally adjusted—and the REER.[11] Owing to data availability, the series for real tax revenue and social benefits are constructed on the basis of nominal data deflated by the GDP deflator.[12] Social transfers are defined as the National Accounts category social benefits (including in kind) for the central government and local authorities.[13] This includes, inter alia, social security benefits; state retirement pensions; sickness, incapacity, maternity, and other government-provided allowances; social assistance, including by means of refundable tax credits; and unemployment benefits. The REER is based on the CPI; although an estimate of the real exchange rate based on unit labor costs would have possibly been preferable, available estimates of the latter would have resulted in a significant loss of statistical degrees of freedom. The vector x_t of exogenous variables includes dummy variables reflecting the different governments in office during the sample period.[14] These dummy variables are introduced to take into account—albeit in an admittedly simplified form—different fiscal policy response functions associated with each

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[11] Seasonally adjusted data were used since some variables (e.g., GDP) are not available in other form. The source of all data series used in this paper is the National Statistics office of the United Kingdom with the exception of the REER, which is from the IMF database; the index of world demand for U.K. exports, which is from the OECD database; and interest rate series, which were provided by the Bank of England. The model was also estimated with the variables set in real per capita terms without any significant change in the results.

[12] Also, since seasonally adjusted data were not available for all taxes before 1987, the X-11 method was used (after deflating the series) for data before that date when necessary. Fiscal variables correspond to the general government, although taxes are not consolidated between central government and local authorities.

[13] See U.K. Office for National Statistics (1998).

[14] A more synthetic dummy variable indicating only the party description of each government in office (i.e., Labour or Conservative Party governments) was statistically less significant than dummies for each of the individual governments.

government. The choice of the sample period was dictated by data availability and covers 1979Q1–2001Q3. The data have quarterly periodicity, and this relatively high data frequency plays an important role in the identification of the structural VAR, since it allows us to assume away contemporaneous influences between some variables. The maximum lag l was determined by the likelihood ratio test and set to four.

12. In order to compute the impulse response functions and variance decompositions, the structural form VAR needs to be identified from the estimated parameters from equation (1). To identify the VAR, we follow the ideas proposed by Blanchard and Perotti (1999) and use a priori information on the budgetary process and independent estimates of the elasticities of taxes and transfers with respect to output. The structural expression of the VAR has the form

$$\mathbf{A}y_t = \mathbf{A}\boldsymbol{\beta}x_t + \sum_{i=1}^{l} \mathbf{A}\mathbf{H}_i y_{t-i} + v_t \tag{2}$$

where the residuals $v_t = \mathbf{A}u_t$ are restricted to be orthogonal. This restriction, however, is not enough to identify all the components of the 5×5 matrix $\mathbf{A}$.

13. It is in choosing the additional restrictions that we use a priori information. Specifically, the matrix $\mathbf{A}$ is assumed to have the following structure:

$$v_t = \mathbf{A}u_t = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ x & 1 & x & -\varepsilon_{\mathrm{Tx,GDP}} & 0 \\ x & 0 & 1 & -\varepsilon_{\mathrm{Tr,GDP}} & 0 \\ x & x & x & 1 & 0 \\ x & x & x & x & 1 \end{pmatrix} u_t \tag{3}$$

where the x's indicate unrestricted unknown coefficients. This postulated structure of the matrix $\mathbf{A}$ renders the structural VAR model exactly identified.

14. Bearing in mind that $\mathbf{A}$ represents the matrix of contemporaneous transmission of shocks across the state variables, the restrictions imposed by (3) can be motivated as follows. The first row indicates that government consumption is not influenced, within the quarter, by shocks to the other state variables. It is postulated that the quarterly periodicity of the data does not allow government consumption expenditure enough time to react, either by automatic mechanisms or by deliberate policy action, within the period. This appears plausible in view of informational and statistical lags (e.g., GDP data are only released after the end of the quarter) and internal lags in the budgetary and expenditure administration process. The second and third rows in (3) indicate restrictions on the effect within the quarter of shocks elsewhere in the system on tax collections and social transfers, respectively. The postulated structure implies that shocks to tax revenue do not affect transfers and that shocks

to the REER do not affect taxes or transfers.[15] Shocks to transfers, however, may affect tax revenue—for example, because some transfers are part of taxable income. The impact of shocks to GDP on taxes and transfers is given by the elasticities of these variables with respect to output: $\varepsilon_{Tx,GDP}$ and $\varepsilon_{Tr,GDP}$. These values are set to 1.1 and –0.5 respectively, on the basis of existing estimates of the automatic stabilizers.[16] Other values of the elasticities, within a reasonable range of existing estimates were also tried without significant changes in the results. Finally, the two last lines of the matrix **A** in (3) indicate that the impacts of all other variables on the REER are left unrestricted, whereas the contemporaneous impact of the REER on output is set to zero. The unrestricted coefficients in (3) were estimated by maximum likelihood.[17]

C. Results and Extensions of the Basic Model

15. The empirical results of the methodology described in the previous section indicate that the fiscal multipliers of budgetary aggregates on output and the REER are small and often statistically nonsignificant.[18] Figure 2 shows the impulse response functions with confidence bands corresponding to two standard deviations.[19] Since the variables are

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[15] This implies in turn that the causality, if any, in contemporary comovements between the REER and taxes or transfers runs from the fiscal policy variables to the real exchange rate. Hence, any bias introduced by this assumption is likely to magnify the estimate of the fiscal multipliers.

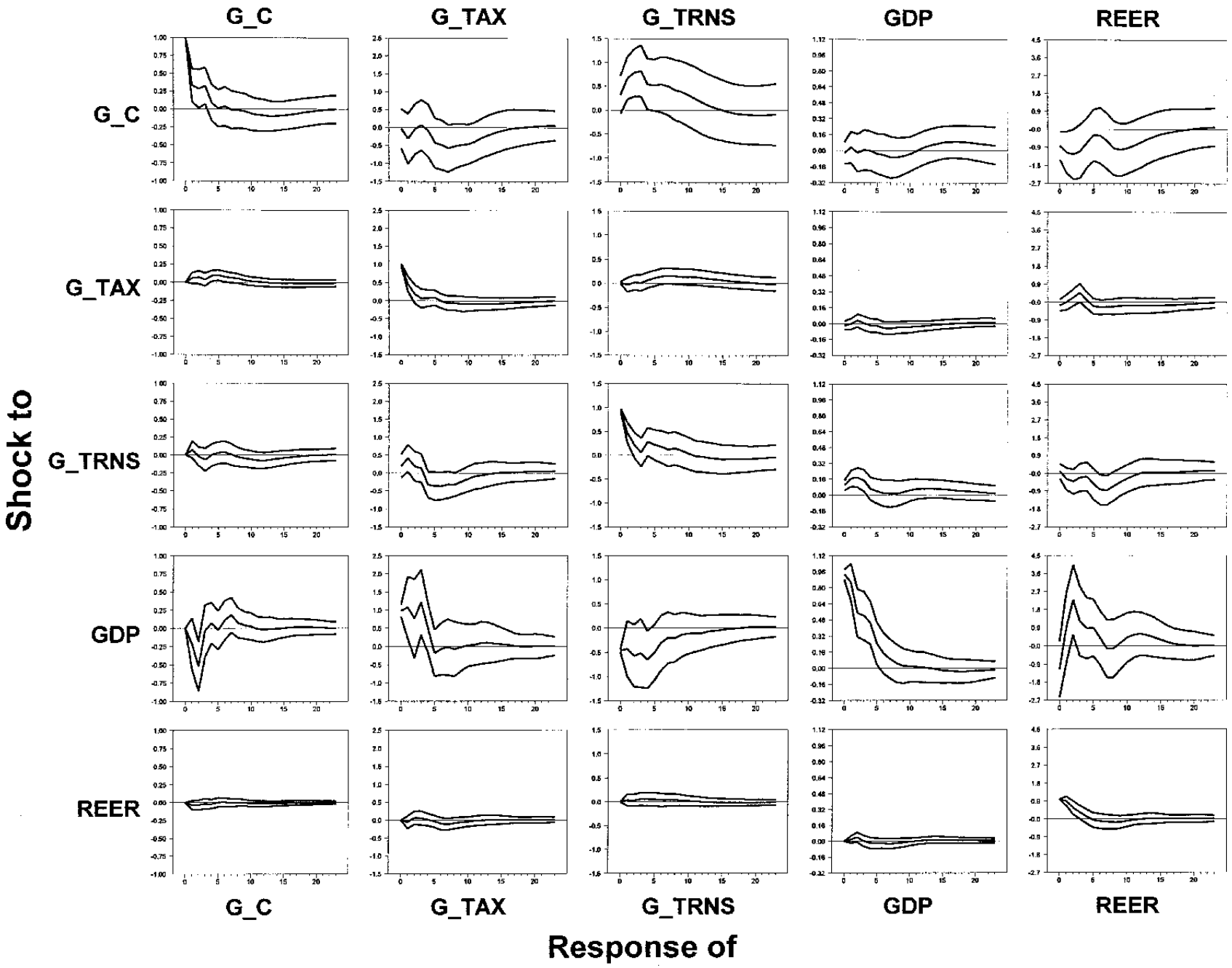
[16] See van den Noord (2000) and HM Treasury (1999a and 1999b). Also, since the translation of annual elasticities into quarterly elasticities is not necessarily trivial, regressions of quarterly data were run to verify the values chosen.

[17] See Hamilton (1994).

[18] If fiscal policy has nonlinear effects, with Keynesian effects operating in "normal" times and non-Keynesian effects dominating when confidence and expectational effects are strong, the estimates of the fiscal multipliers should probably be interpreted as an "average" over the sample period, with one effect offsetting the other.

[19] Confidence bands were obtained by Monte Carlo simulation. The panels in Figure 2 show the impulse response functions of the variables in the horizontal axis to shocks to the variables in the vertical axis. Thus, for example, the column labeled as GDP shows the response of GDP at different lags to shocks in the variables labeled in the vertical axis, and the three first vertical panels in that column can be interpreted as the traditional fiscal multipliers of government consumption, taxes, and transfers respectively. Incidentally, the model computes as a by-product the automatic stabilizers, that is, the impact of an increase in output on the budgetary variables considered. These are the impulse response functions of the budgetary aggregates to a shock to GDP (i.e., the three first panels of the row corresponding to the GDP in Figure 2). They show the conventional signs and magnitudes consistent with existing estimates (see van den Noord (2000) and HM Treasury (1999a and 1999b)).

Figure 2. UK: Basic Model--Impulse Responses



logarithmically transformed, the values of the impulse response functions can be interpreted as elasticities at the corresponding lag. The only fiscal policy impact that is statistically significant is the expansionary effect on output of social transfers. The response of output to an increase in transfers is significantly positive during the first year with a peak elasticity of about 0.17. Given that social transfers have represented about ¼ of GDP in recent years, the estimated values of the impulse response function mean that an increase in transfers of 1 percent of (quarterly) GDP in one quarter is estimated to result in a GDP increase of between ½ and ⅔ of a percentage point of GDP over the following year. A possible explanation of this result is that, since social transfers are fairly well targeted in the United Kingdom, they accrue mainly to liquidity-constrained households with a high propensity to consume out of income, which offsets any potential Ricardian or confidence effects. Conversely, the progressivity of the tax system may result in tax changes accruing mainly to non-liquidity-constraint households, which are more likely to behave according to the Ricardian equivalence hypothesis. Thus, although a tax increase has a slightly contractionary effect during two quarters, the latter is subsequently offset. Government consumption has virtually no effect on output with any lag.

16. The estimated impact of the three budgetary variables on the REER shows the opposite direction to that typically implied by Mundell-Fleming theory—although the values are only marginally significant and even that, only at some lags.[20] Overall, increases in government spending appear associated to a depreciation of the REER, while the converse obtains for tax increases. This would be consistent with the hypothesis that confidence effects offset or even dominate conventional Keynesian effects.

17. In order to throw some light on the transmission channels of fiscal policy and the possible reasons for the results, private consumption and business investment were added, one at a time, to the basic model, exploring the effects on private demand of fiscal policies. The results are consistent with the hypothesis that contractionary fiscal policies may have an expansionary effect on private demand. The corresponding impulse-response functions are shown in Figures 3 and 4. The results from introducing private consumption indicate that the latter tends to contract (expand) following expansions (contractions) on government consumption.[21] In contrast, private consumption expands (significantly at 5 percent probability) during the first eight quarters after an increase in social transfers. This behavior of consumption is consistent with and could explain the anomalous shape of the fiscal multiplier of government consumption as well as the conventional shape of the multiplier of social transfers, since the estimated impulse-response functions appear to indicate that output responds significantly to shocks in private consumption. Finally, an expansion in private

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[20] The REER is normalized to 100 in 1990 and has oscillated around 111 in recent times. Therefore, a one percent increase and an increase of one percentage point are roughly equivalent.

[21] This effect is significant at 10 percent probability but not at 5 percent. Nevertheless, given that consumption represents a large proportion of GDP (about 68 percent), even a small contraction of private consumption may have large output effects.

Figure 3. UK: Adding Private Consumption--Impulse Responses

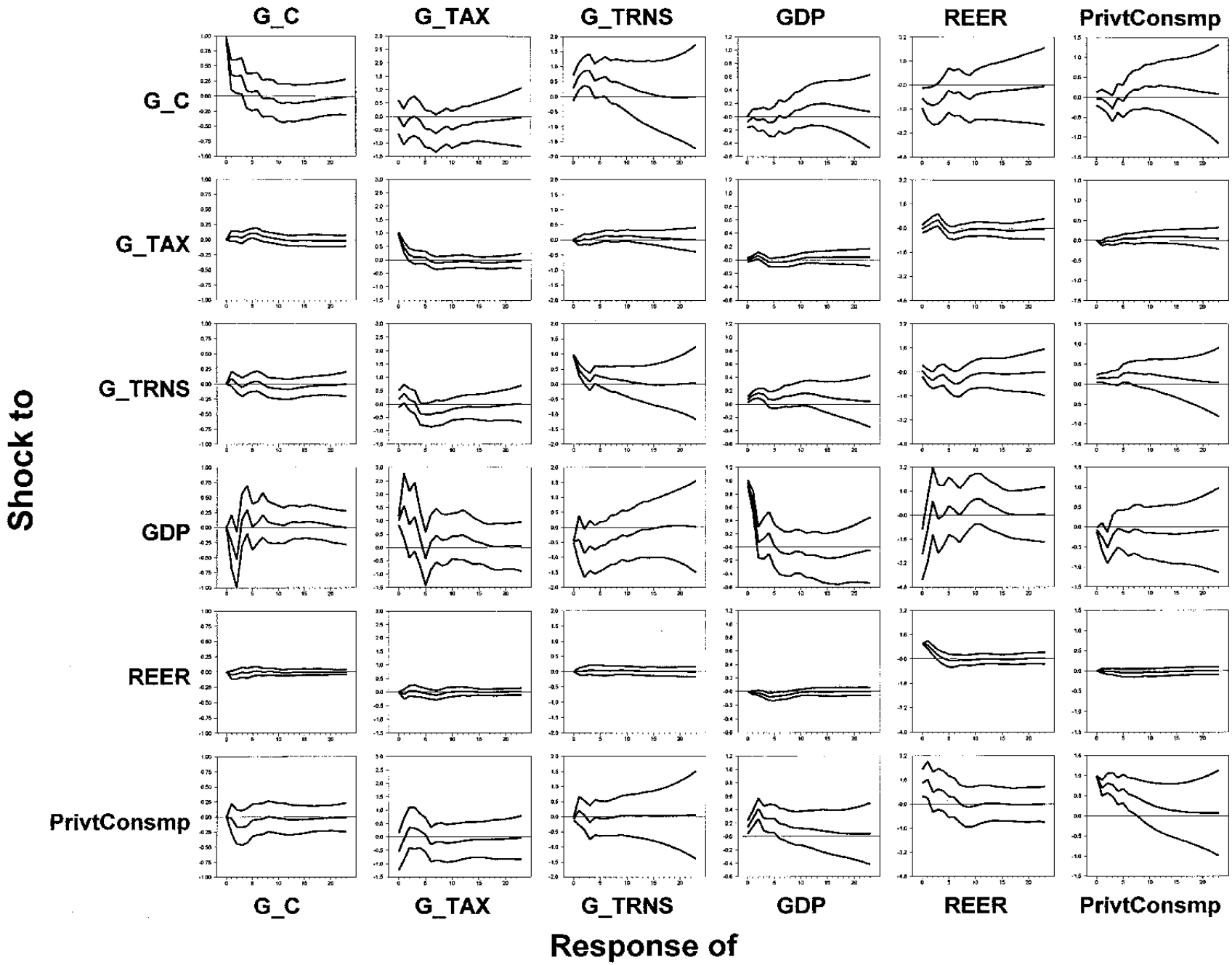
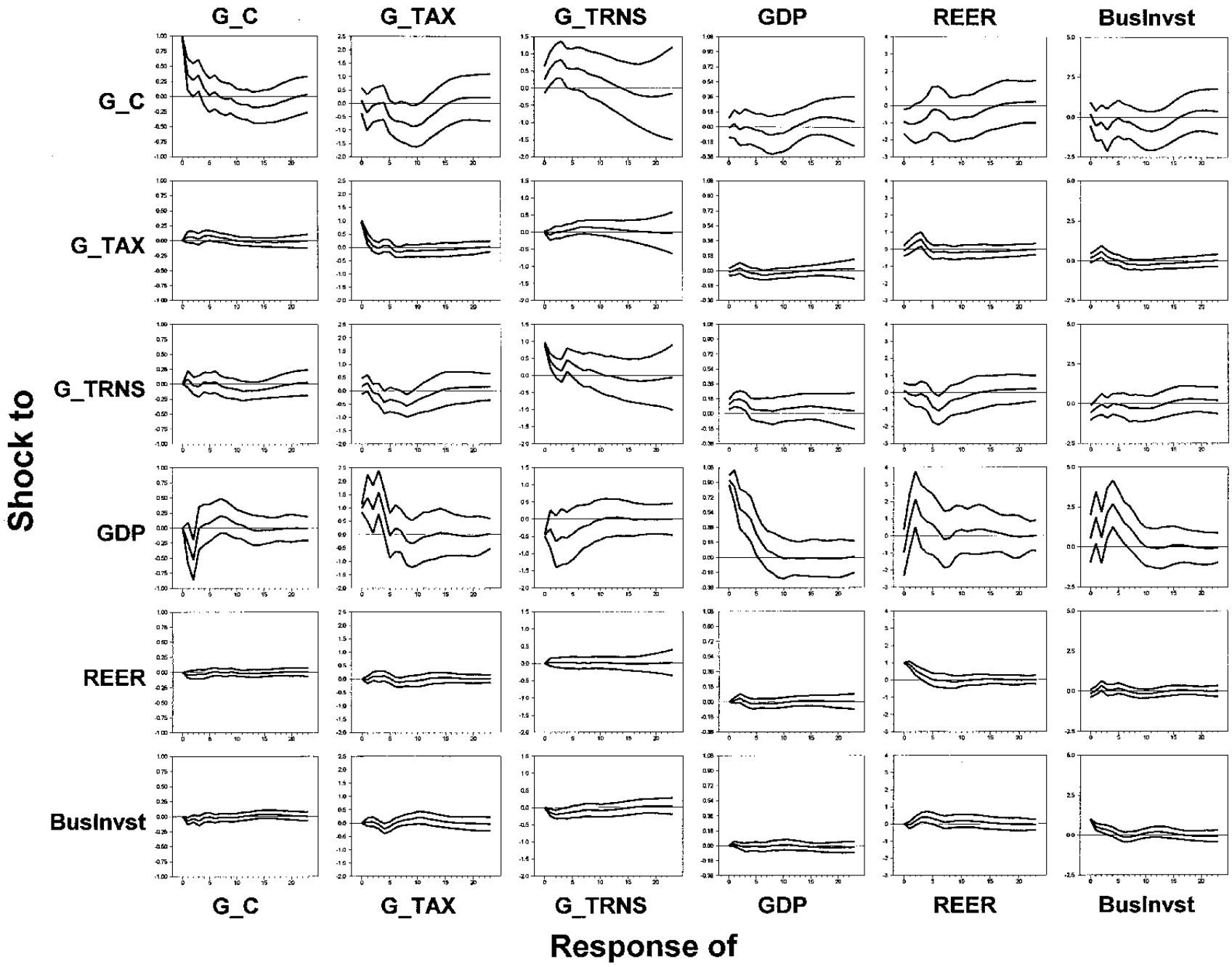


Figure 4. UK: Adding Business Investment--Impulse Responses



consumption appreciates the REER as it could be expected. Private investment contracts following an expansion in government consumption and increases after a tax increase (slightly and for a short period, but significantly from a statistical standpoint). This apparently unconventional behavior of investment vis-à-vis taxation is consistent with expectational and confidence effects.[22]

18. Other extensions to the basic model were also considered. In particular, there is the possibility that low estimated values of the dynamic multipliers could result from fiscal policies conducted with a view to offset shocks in external demand. Thus, for example, if expansions in government consumption were systematically associated with negative external shocks and designed to offset the effect of these shocks on output, the multiplier of government consumption estimated with the omission of external demand would likely be close to zero. This would, in fact, reflect the effectiveness of fiscal policy and not the reverse. In order to address this possibility, the basic model was augmented by including an index of effective world demand for U.K. exports as exogenous variable (with several lag structures). Although world demand was statistically significant in the equation of government consumption, the estimates of the dynamic multipliers and results commented above did not change in any significant way. Finally, in order to explore existence of crowding out effects of fiscal policy through changes in the interest rate, the basic model was also augmented by introducing short-term and long-term interest rates.[23] The results of this exercise did not provide any evidence of this channel of transmission of contractionary effects of expansionary fiscal policies (or vice versa).[24]

D. Conclusions and Additional Remarks

19. This paper has explored the empirical linkages between fiscal policy variables and output, the REER, and private demand in the United Kingdom during the last 23 years. We find that the impact of the fiscal policy variables is weak, with only social transfers exhibiting unequivocally standard Keynesian effects. Government consumption and taxes

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[22] The estimated effects of taxation on consumption and investment have opposite directions. This is consistent with Keynesian theory, which in turn is agnostic about the sign, as pointed out in Blanchard and Perotti (1999). They find that a positive shock to taxation has strong negative effects on both consumption and investment in the United States.

[23] The interest rate variables corresponded to three-month LIBOR and three-year government maturities.

[24] In fact, the estimated response of short-term rates to a positive shock to government expenditure (consumption and, to a lesser extent, transfers) was a statistically significant decline in rates. This could reflect the possibility that fiscal and interest rate policies were typically undertaken jointly and with the same direction during the sample period. In this regard, notice that the Bank of England did not obtain operational independence until 1997. Until then, the Treasury had ultimate responsibility for setting the policy interest rate, as well as for budgetary policies.

show, on balance, non-Keynesian effects on output, demand, and the REER. This could be due to the existence of nonlinearities in the fiscal policy transmission mechanism, stemming from confidence and expectational effects which could occasionally reverse the conventional direction of the impact of fiscal policy. If this were the case, the small value of the fiscal multipliers could be the result of offsetting opposite values during different fiscal policy episodes. Exploring these hypotheses, however, requires further evidence.

20. Existing evidence indicates that the non-Keynesian effects of government consumption and taxes are transmitted through their impact on private demand. Positive shocks to government consumption tend to depress private consumption (at least initially) and business investment. Social transfers have a stimulating effect on output and private consumption—perhaps owing to their being targeted to liquidity-constrained households—and only a very small initial negative effect on investment.

21. It must be pointed out that a small estimated size of the fiscal multipliers or the existence of nonlinearities is not necessarily inconsistent with standard Keynesian theory. The latter postulates that significant fiscal multipliers should be associated with the existence of economic slack, but not with situations when output is close to potential. For example, the full employment multipliers of government spending and tax cuts could be small as the crowding out effect of higher interest rates and spillovers through the trade balance may dominate. In practice, however, most observers would agree that actual output remained below potential in the United Kingdom for most of the period under scrutiny.[25] Moreover, we did not find statistical evidence of increases in interest rates after expansionary fiscal shocks, or vice versa—rather, the opposite appears to have occurred. Thus, it is unlikely that the main statistical results stem exclusively from standard crowding out effects, although these may have been occasionally a contributing factor.

[25] For example, with the exception of 1979-1980 and 1989-1990 unemployment is estimated to have been above 6 percent.

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II. Why Has U.K. Household Consumption Been so Strong?[1]

A. Overview and Introduction

1. This study constructs a dynamic model of household consumption in the United Kingdom to analyze its recent behavior and to assess its prospects. The recent strength of household consumption in the United Kingdom is explained to a considerable extent by income gains over the recent past, though steady gains in house prices have also played a role. The wealth effect from house prices appears to dominate that from financial wealth in the short run, but the difference diminishes in the long run. Confidence factors and the ability to borrow against collateral (reflecting mortgage equity withdrawal) appear to be influencing consumption in the short run. The model suggests that household consumption in the United Kingdom should prove quite resilient to moderate shocks stemming from asset price declines, but the prospects for consumption do depend—among other factors—on orderly developments in the housing market.

2. Despite the marked fall in equity prices in the United Kingdom since March 2000, household consumption has remained remarkably resilient (Figure 1). Growth of household consumption has been underpinned by increases in personal incomes, which in turn have reflected steady increases in earnings and strong employment gains over the past few years (Figure 2). Consistent with smoothing behavior, household consumption has been less volatile than personal income. Despite the substantial decline in equity prices, continued strength in house prices has helped sustain the pace of consumption, while, at the same time, household indebtedness has risen markedly (middle and lower panels of Figure 1).

3. **This study addresses the following questions:**

- What are the main determinants of household consumption in the United Kingdom? Are wealth effects among them, and which asset prices are most relevant?
- More specifically, have strong gains in housing wealth been among the main factors behind the recent strength of consumption? In addition, has the responsiveness of consumption to housing wealth increased in recent years?
- Has rising consumer borrowing—including mortgage equity withdrawal—been a contributing factor to the recent strength of consumption?
- What are the prospects for consumption should a major decline in asset (particularly house) prices take place?

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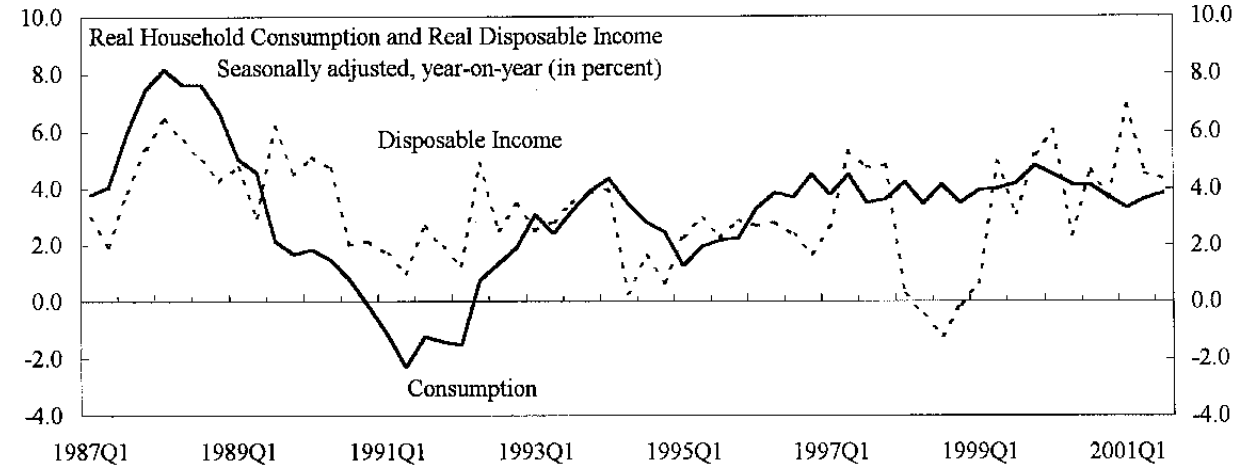
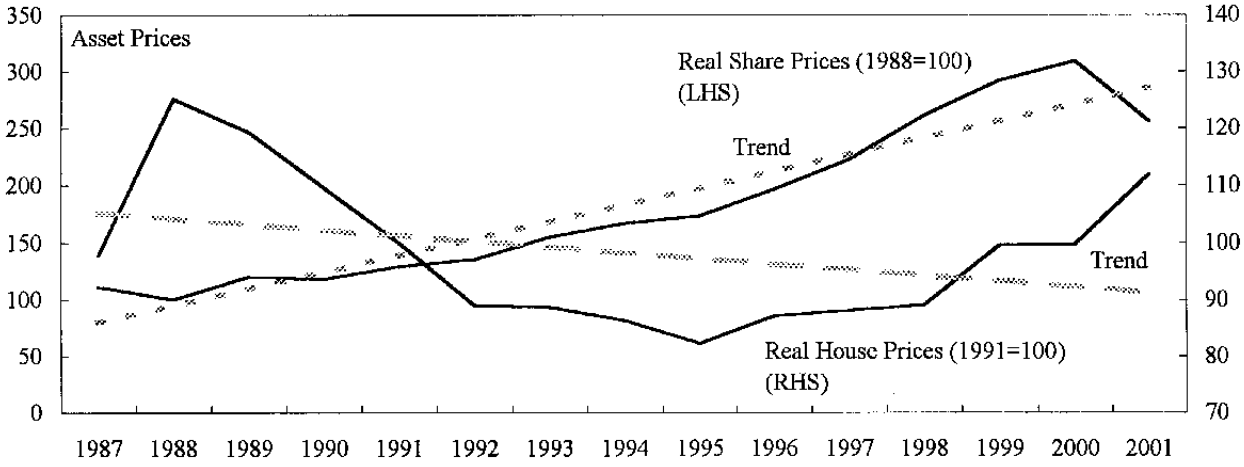
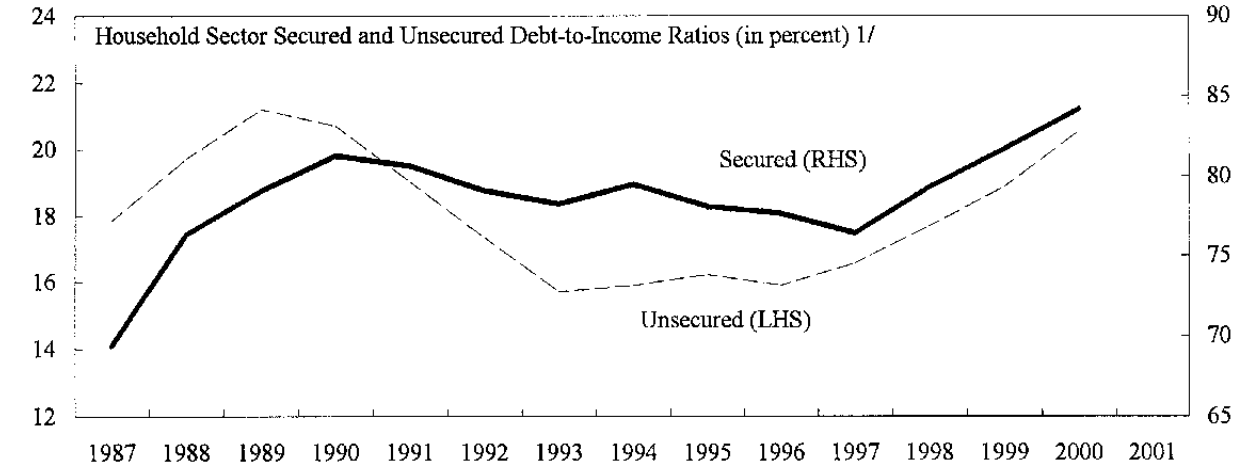
[1] Prepared by Dimitri Tzanninis.

Figure 1. United Kingdom: Household Indicators, 1987-2001

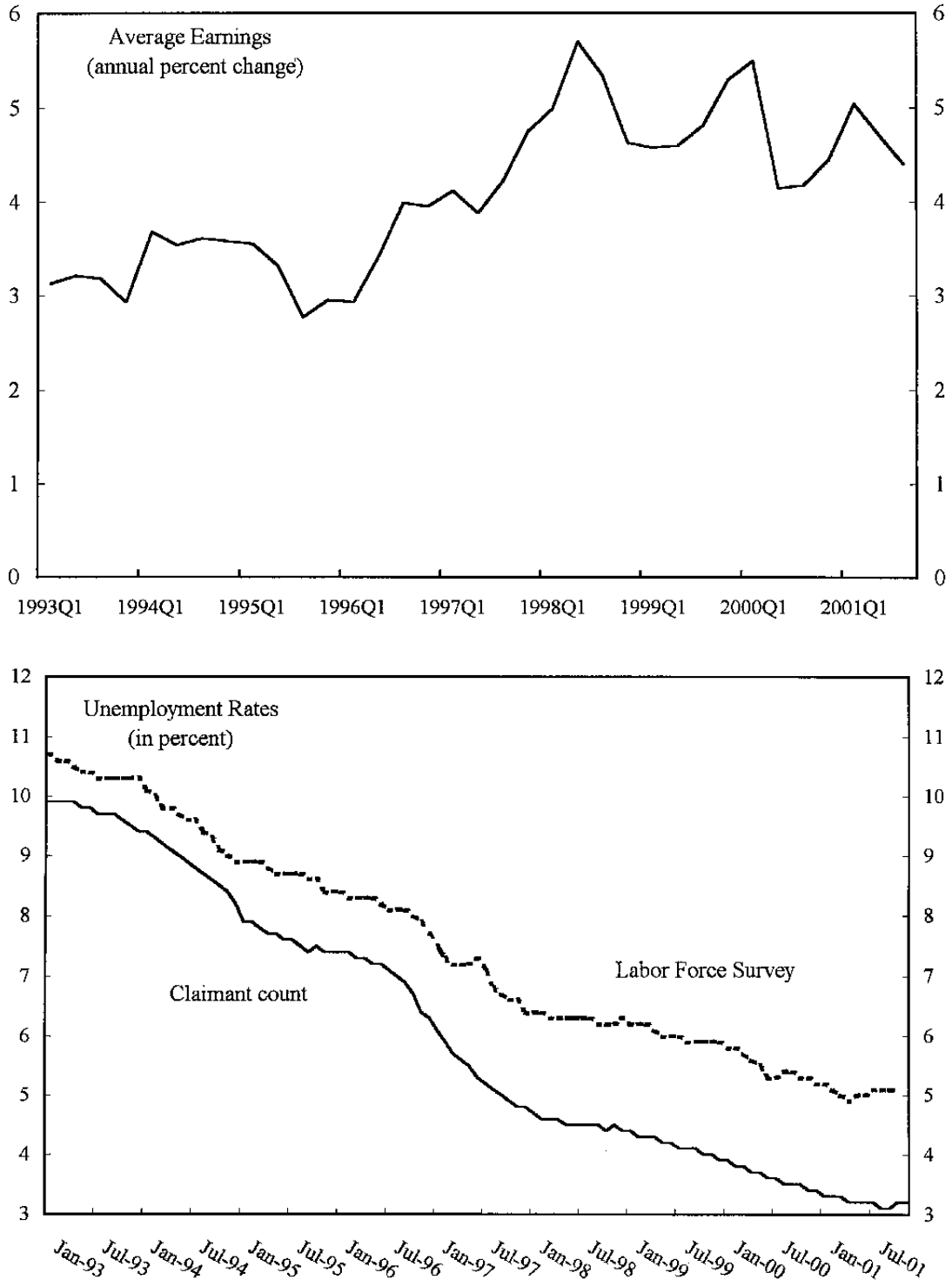






Sources: Bank of England; Bloomberg; and National Statistics (ONS).
1/ In terms of gross disposable income.

Figure 2. United Kingdom: Labor Market Indicators, 1993-2001



Source: National Statistics (ONS).

4. Numerous studies of household consumption in the United Kingdom have pointed to the importance of income and wealth variables in explaining the behavior of consumption in the long run, and to a variety of other—primarily wealth and confidence—variables in explaining short-run consumption dynamics.[2] Recognizing the potentially different impact on consumption of gains in various asset classes, some studies have explicitly separated wealth effects in an effort to assess their relative importance.[3] While the methodology and potential explanatory variables in the analysis of consumption have been largely established in the literature, the questions that each study addresses do not necessarily reflect the issues noted above. Low interest rates in recent years and rising housing wealth have fueled secured household borrowing (including mortgage equity withdrawal) and may have been a contributing factor to the recent strength of consumption. Should the value of the collateral decline or interest rates rise sharply, this factor could potentially impact consumption adversely. It is thus a valid empirical question whether, and to what extent, mortgage equity withdrawal influences the short-run behavior of consumption. However, only a handful of studies have attempted to assess the impact of mortgage equity withdrawal on consumption by modeling explicitly the ability of households to borrow against physical collateral.[4]

5. This study aims to contribute to the understanding of U.K. household consumption in the following respects. First, the study differentiates explicitly among various asset classes to account for the impact on consumption of differences in liquidity and realization of gains. While wealth decomposition is nothing new in studies of consumption, many have either used data on disaggregated financial wealth only or have employed price indices as proxies for wealth, thus abstracting from changes in the actual stock of wealth. Second, the study models explicitly the short-term impact on consumption of household borrowing secured on dwellings to assess the role of mortgage equity withdrawal. Finally, the study examines whether the gains in house prices in recent years have been accompanied by a larger influence of housing wealth on household consumption decisions, thereby raising the prospect of a large shock to consumption should a major adjustment of house prices take place.

6. This study formulates a model of household consumption in the United Kingdom that is reduced to a parsimonious single-equation representation to describe the dynamic behavior of household consumption. To put the econometric formulation in perspective, Section B provides a brief overview of the theoretical foundation of the model. Section C uncovers an

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[2] Church *et al* (1994) present a survey of U.K. consumption functions.

[3] For recent studies, see Byrne and Davis (2001) on the United Kingdom, and Boone *et al* (2001) and Ludwig and Sløk (2002) on a group of OECD countries, including the United Kingdom.

[4] For example, Boone *et al* (2001).

equilibrium long-run relationship between household consumption and its fundamental determinants, and in the process evaluates the impact of individual factors on the behavior of household consumption over the long run. Section D describes a consumption equation that captures both short- and long-run dynamics, and performs experiments to assess the impact on household consumption of large shocks to its determinants. Section E summarizes the results. Finally, Section F contains concluding remarks.

7. The model, which is intuitively appealing, fits the data remarkably well. The main results can be summarized as follows:

- By far, the principal determinant of household consumption in the long run is personal disposable income; wealth effects play a secondary—though still important—role.

- The influence of housing wealth on household consumption is much larger than that of financial wealth in the short run, but the difference diminishes in the long run.

- The boost to household consumption from the availability of borrowing secured on dwellings (a proxy for mortgage equity withdrawal) is strong but short-lived: secured borrowing tends to raise consumption strongly in the very short run, but suppresses it in the long run (as should be expected of any gross liability).[5]

- Among the short-run influences on household consumption, variables capturing consumer confidence play a prominent role.

- The impact on consumption growth of a large (say, 10 percent) correction in house prices would be relatively muted and short-lived, but much larger and protracted declines of house prices could potentially cause household consumption to contract for a few quarters.

B. The Theoretical Model

8. The theoretical foundation of the estimated model is provided by the vast literature on the life cycle/permanent income hypothesis of consumption.[6] Under this hypothesis, planned consumption C^P is a positive function of total resources, which in turn are the sum of human and other net wealth:

$C^P = f(\text{Human Wealth, Wealth})$

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[5] Mortgage equity withdrawal is the part of household borrowing secured on dwellings that is not invested in them, but is available for reinvestment or consumption. See Davey (2001).

[6] See Ando and Modigliani (1963) and the survey of literature provided in Deaton (1992).

Given that planned consumption is unobservable, actual consumption at time t, $CONS_t$, and planned consumption are related as follows:

$CONS_t = f_t(\text{Human Wealth, Wealth}) + \varepsilon_t$

Furthermore, human wealth—represented by the present discounted value of labor income—is unobservable, but can be proxied by some function of contemporaneous labor income $INCO_t$. In addition, other net wealth can be broken down in its two components, net housing wealth, HOU_W_t, and net financial wealth, FIN_W_t. We can therefore derive the following log-linear long-run household consumption equation:[7]

$$\ln(CONS_t) = \beta_0 + \beta_1 \ln(INCO_t) + \beta_2 \ln(HOU\_W_t) + \beta_3 \ln(FIN\_W_t) + \theta_t$$

9. The pure form of the life cycle/permanent income hypothesis of consumption has not fared well in empirical tests. Consequently, researchers have tried to augment the theoretical model by including additional explanatory variables. Such variables typically include a real interest rate (to capture intertemporal substitution effects), the inflation rate (to capture uncertainty as well as the real depreciation of non-indexed financial assets), and the unemployment rate (to capture uncertainty surrounding future income). Some of these variables are expected to explain better the short-run dynamics of consumption (inflation and unemployment), while others (such as the real interest rate) are expected to enter the consumption decision over the longer run.

C. Estimation of the Long-run Household Consumption Function

10. Using quarterly data for 1987:Q4 – 2001:Q3, a long-run cointegrating relationship (interpreted as a steady-state equilibrium) was estimated between household consumption and its fundamental determinants: disposable income, net housing wealth, net financial wealth, and the real interest rate.[8]

$$cons_t = 0.854*inco_t + 0.102*hou\_w_t + 0.043*fin\_w_t - 0.006*real\_int_t \quad (1)$$

---

[7] Theory does not prescribe a functional form for consumption. It is therefore an empirical question whether a log-linear representation is appropriate.

[8] All variables are expressed in real terms. Lower case letters denote logarithms of the variables introduced above. Therefore, the estimated coefficients can be interpreted as long-run elasticities. See the Appendix for a detailed discussion of the series used, the statistical tests, and the estimation results.

11. Figure 3 (upper panel) presents a decomposition of the long-run cointegrating relationship, revealing the relative contributions of the fundamental determinants of consumption.

12. The statistical evidence suggests that:

- There is a stable long-run relationship between household consumption in the United Kingdom and its fundamental determinants. This relationship satisfies the theoretical requirement of homogeneity of order one (i.e., the sum of the estimated coefficients of income and wealth is equal to one).[9]

- Household consumption over the long run is highly sensitive to developments in disposable income, the long-run elasticity being 0.85.

- Consumption appears to be more sensitive to changes in net housing wealth than to changes in net financial wealth over the long run.

- Some intertemporal substitution takes place, but the small long-run elasticity of consumption with respect to the real interest rate suggests a very small effect.

- Much of the strength of equilibrium consumption since the mid-1990s—and especially since 1998—is due to growth in real disposable income, with housing and financial wealth gains playing a secondary role (see Figure 3, upper panel). The relative influence of housing wealth appears to have increased somewhat in 2001, dominating the negative effect from the decline in equity prices.

The next step is to combine the long-run relationship with short-run influences in a single dynamic equation of consumption.

D. A Model of Household Consumption

Error-correction model

13. Deviations of consumption from its long-run equilibrium levels do not always reflect disequilibria; they could also reflect temporary factors and adjustment lags. To capture the short-run dynamics, household consumption was modeled in an error-correction representation, using—in addition to the variables mentioned above—the unemployment rate and loans to households secured on dwellings (in constant prices). The unemployment rate is a proxy for uncertainty surrounding future income (capturing precautionary savings) and is

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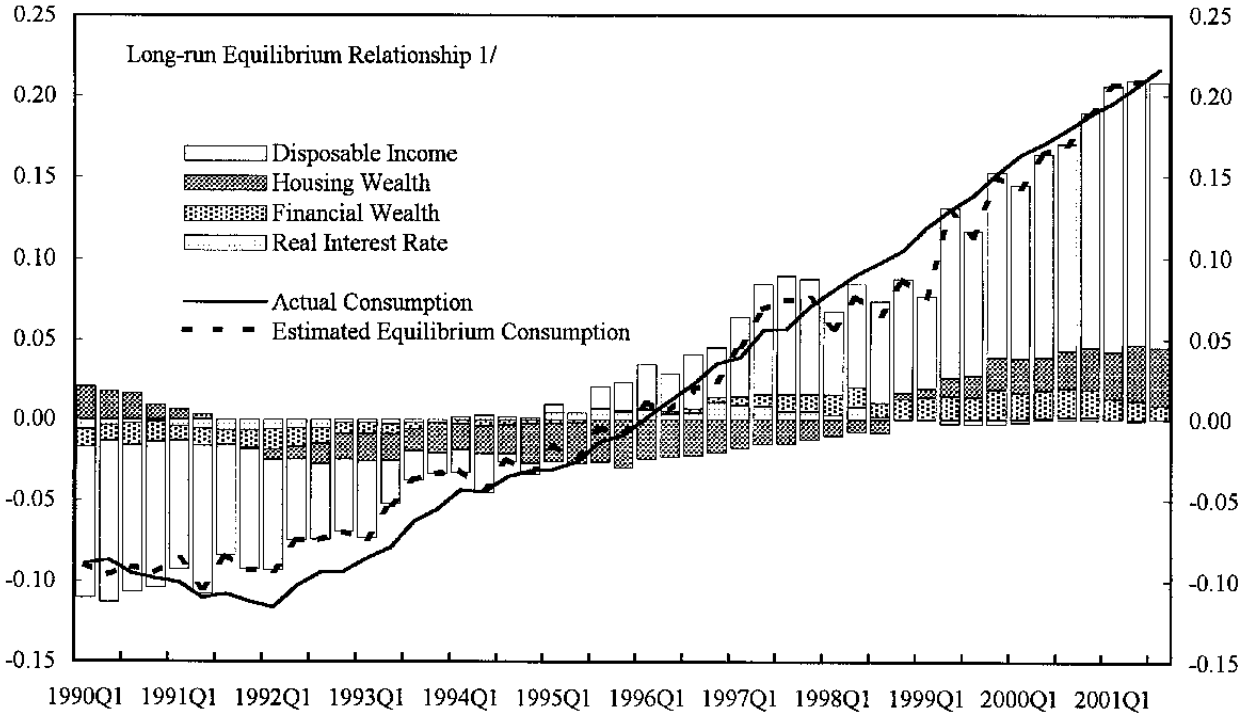
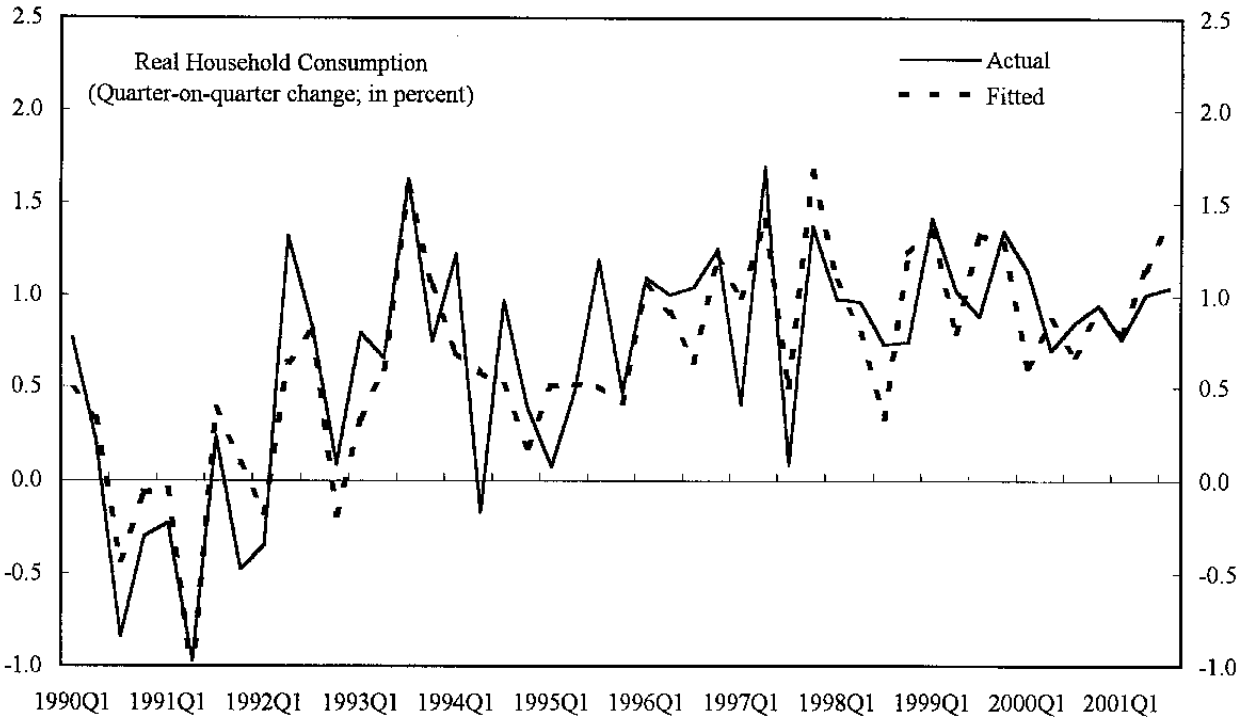
[9] The estimated long-run relationship is similar to the one published by the Bank of England in the September 2000 update of its economic model (Bank of England, 2000):
$cons_t = 0.890*labor\_income_t + 0.110*total\_wealth_t - 0.003*real\_int_t$

Figure 3. United Kingdom: Long-run Equilibrium, and Actual and Fitted Values of Consumption, 1990-2001





Sources: Bank of England; National Statistics (ONS); and IMF staff calculations.

1/ Variables have been scaled so that they have a zero mean over the estimation period.

treated as a consumer confidence indicator: other things constant, an increase in the unemployment rate would cause consumption to contract. The level of borrowing by households secured on dwellings attempts to capture the short-run impact of mortgage equity withdrawal, which some researchers have suggested that has been a contributing factor behind the recent strength of consumption.[10] Theory prescribes a negative sign for this factor over the long run (as is the case for any gross liability), but its sign in the short run is an open empirical question.

14. Starting from a general specification, that includes several lags and variables, and reducing it to a parsimonious representation with the aid of appropriate tests, the estimation yielded the following error-correction model of household consumption:[11]

$$\Delta cons_t = \underset{}{-0.050} \underset{(-3.05)}{-\ 0.043*\Delta unemp_{t-1}} \underset{(-2.80)}{+\ 0.479*\Delta sec\_liab_t} \underset{(5.15)}{-\ 0.420*\Delta sec\_liab_{t-1}} \underset{(-4.77)}{+}$$

$$\underset{(5.24)}{+\ 0.086*\Delta hou\_w_t} \underset{(3.23)}{+\ 0.052*\Delta hou\_w_{t-1}} \underset{(2.42)}{+\ 0.027*\Delta fin\_w_t} \underset{(-3.45)}{-\ 0.137*ECM(cons)_{t-1}}$$

$R\text{-}BAR^2 = 0.730 \qquad \sigma\hat{} = 0.0036$

15. Virtually all estimated coefficients have the anticipated signs, and the equation passes a battery of diagnostic tests. Tests for parameter stability and for the presence of structural breaks confirmed that the results are robust (Figures 4 and 5).[12] Furthermore, the estimated model fits the data well, suggesting that the recent strength of consumption can be explained adequately by the variables included in the analysis (see lower panel of Figure 3).[13]

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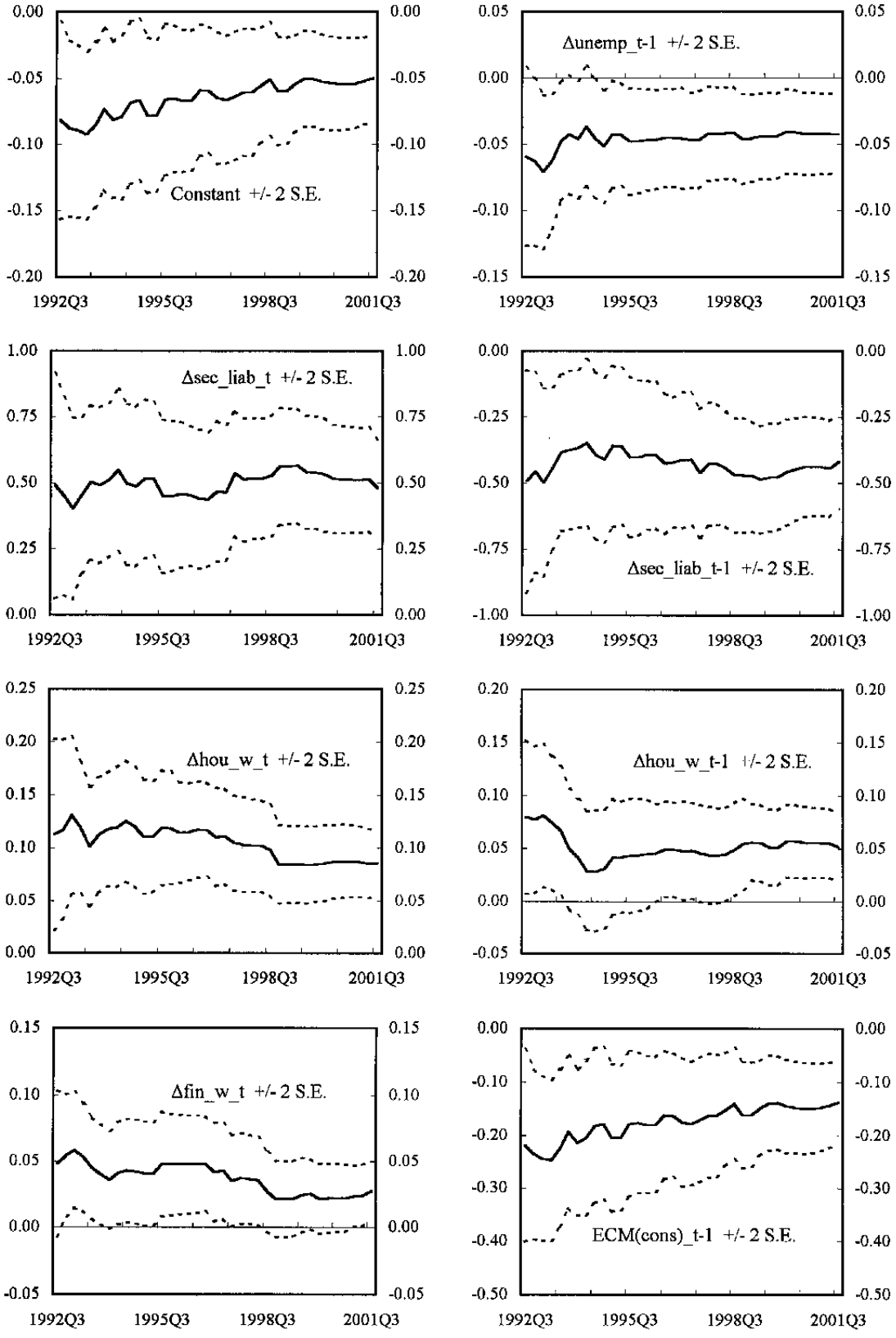
[10] See, for example, Davey (2001).

[11] The notation Δ denotes first differences in the logarithms of the variables, which can be interpreted as the quarter-on-quarter growth rates of the underlying variables. Standard t-ratios are reported in parentheses. Only significant coefficients are reported. $ECM(cons)_{t-1}$ is the lagged deviation of actual consumption from the long-run relationship derived in (1) above; together with its coefficient, it represents the error-correction term capturing the adjustment of consumption to deviations from its long-run equilibrium.

[12] See Appendix, Section D for a detailed explanation of the tests.

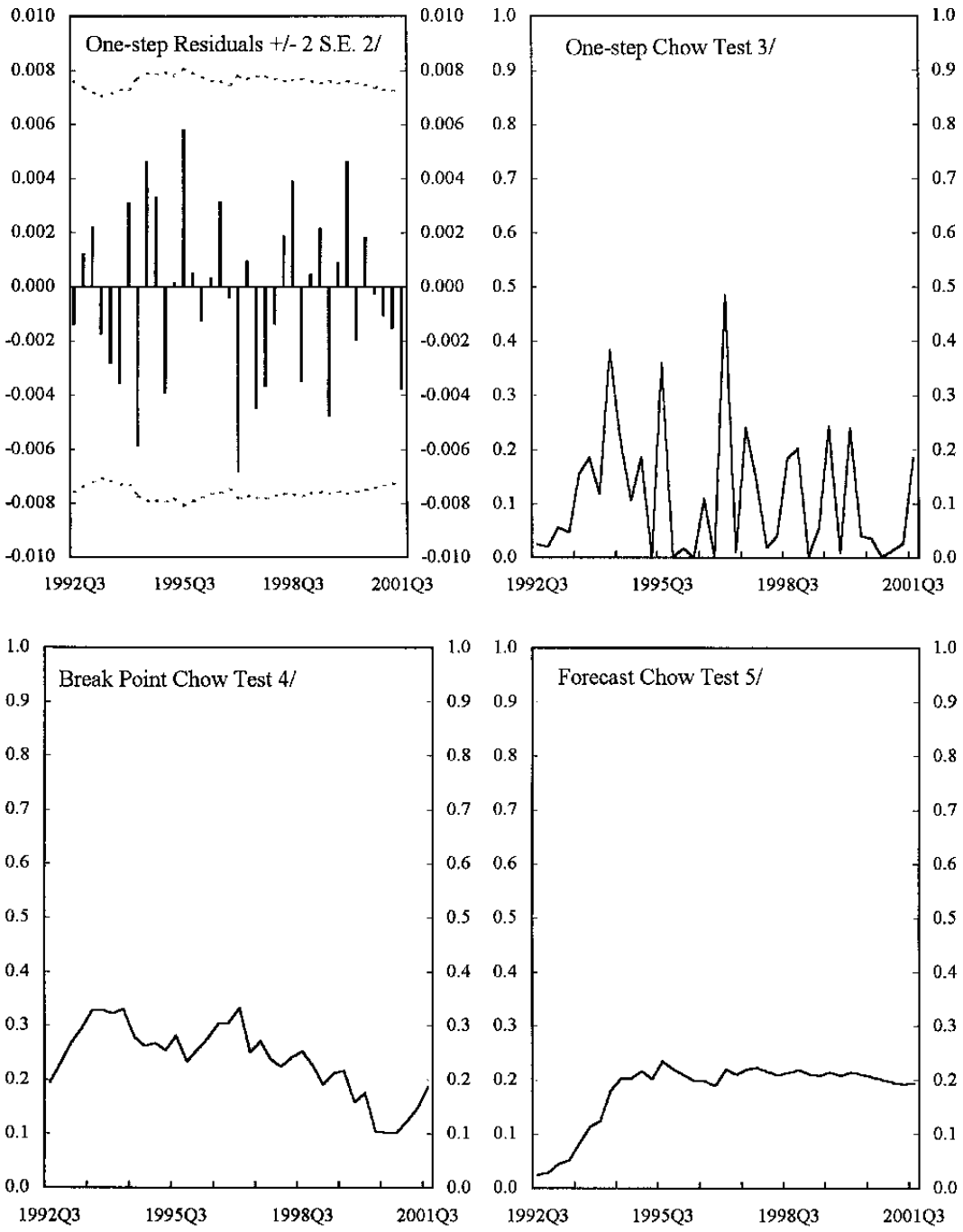
[13] The in-sample forecast errors for 2000-01 are within the standard error of the regression. See also footnote 14 below.

Figure 4. United Kingdom: Parameter Stability, 1992-2001



Source: IMF staff estimates.

Figure 5. United Kingdom: Tests for Structural Breaks, 1992-2001 1/



Source: IMF staff calculations.

1/ Test values in panels two through four are scaled by one-off critical values from the F-distribution at the 1 percent probability level as adjustment for changing degrees of freedom. Test values below 1.0 cannot reject the null hypothesis.

2/ Points outside the 2 standard-error region are either outliers or are associated with coefficient changes.

3/ One-step forecast test of the null hypothesis of constant parameters.

4/ Chow tests of the null hypothesis of no difference between the N-periods-ahead and one-period ahead forecasts.

5/ Chow tests of the null hypothesis of no difference between the one-period-ahead and N-periods-ahead forecasts.

Dynamic simulations

16. How much did the strength of consumption growth in 2001 depend on increases in house prices? A dynamic simulation of the above error-correction model—which involved holding housing wealth constant at its end-2000 level during 2001—indicates that consumption growth would have slowed, but held up at a sustainable pace of around 3 percent (Figure 6).[14] This confirms the result from decomposing the cointegrating relationship that much of the recent strength in consumption derives from steady increases in real disposable income (see Figure 3).

17. Dynamic simulations were also performed to test the response of consumption to large, counterfactual shocks to its determinants. Each determinant was subjected to a structured shock and the depth and duration of the impact on consumption was observed (Figures 7 and 8).[15] The experiments suggest that consumption is quite resilient to relatively large adverse shocks to its determinants, though the extent and duration of the impact on consumption growth does vary considerably among the controlled variables.

18. The counterfactual simulations should be interpreted with caution because they are based on partial analysis. With given paths for the explanatory variables, the simulations preclude feedbacks between variables. For instance, it is likely that a decline in housing wealth of the magnitude assumed in the experiment (close to 10 percent) would be accompanied by other developments (such as erosion of confidence) that could have a larger impact on consumption than the one suggested by the experiments.

E. Summary of Results

19. The main results can be summarized as follows:

- **Household disposable income does not appear to have a statistically significant influence on household consumption in the short run.** This result suggests

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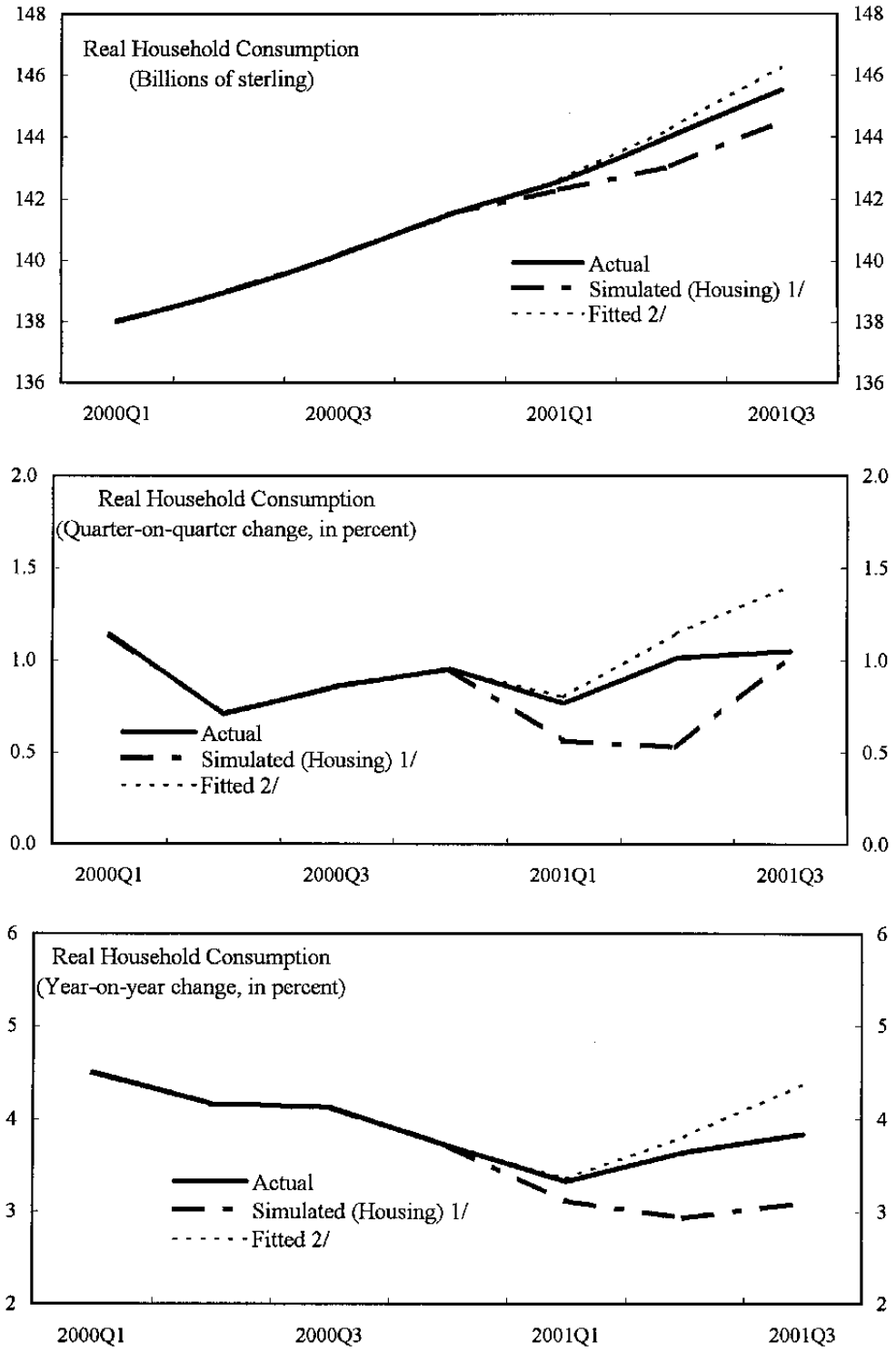
[14] Given that recent national income accounts data (including consumption) tend to be revised, the results for 2001 are necessarily tentative.

[15] Each explanatory variable was subjected to a negative shock in 1999:Q4, equivalent to two standard deviations below the average year-on-year historical rates of change (this implied an increase in the unemployment rate). The variable was interpolated linearly between 1998:Q4 (the last actual value) and 1999:Q4 (the period where the full force of the shock was felt), and remained unchanged thereafter. All other explanatory variables assumed their actual values. The starting point of the simulation was selected to allow the dynamics to play out fully by the end of the period (2001:Q3).

Figure 6. United Kingdom: Real Household Consumption, 2000-01

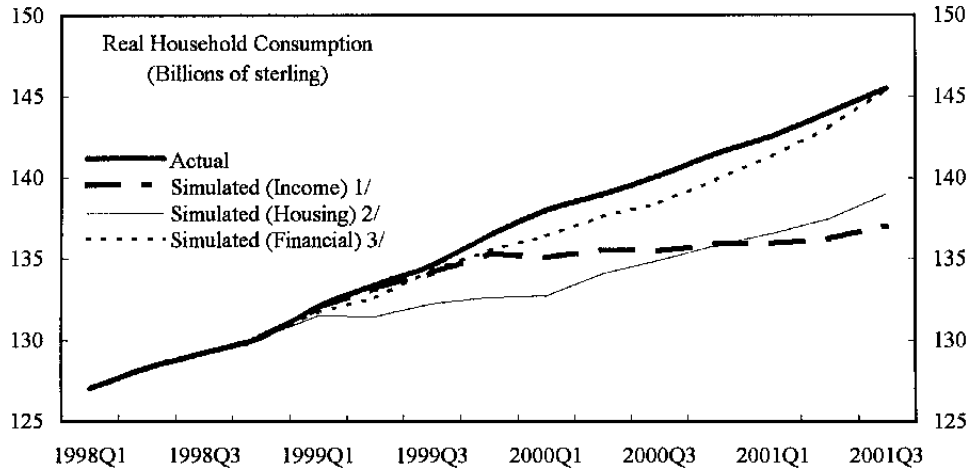


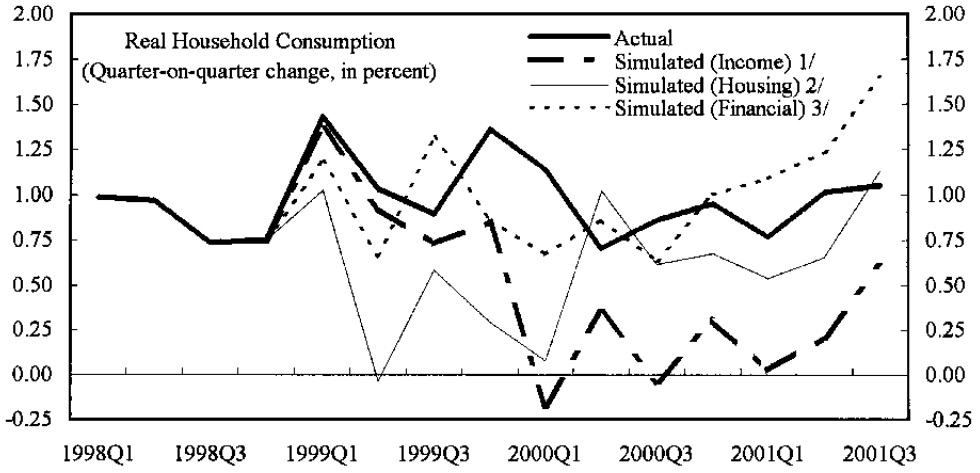
Sources: Bank of England; National Statistics (ONS); and IMF staff estimates.

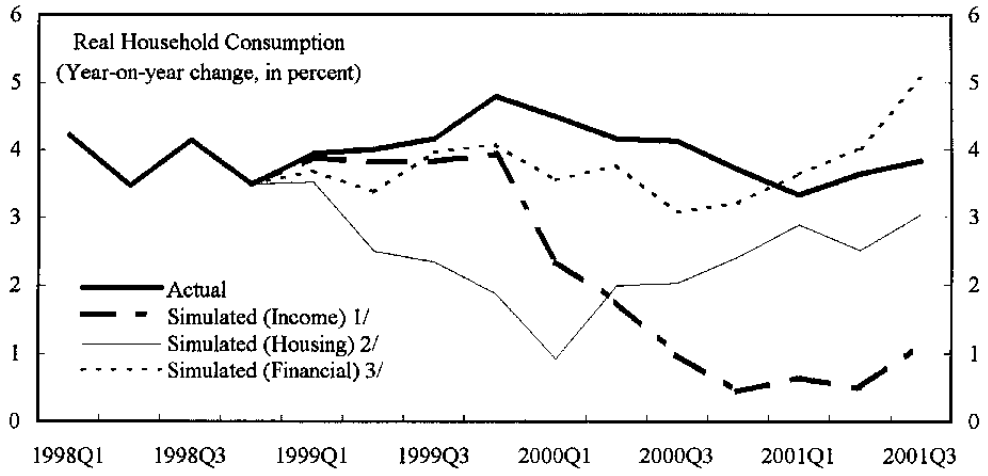
1/ Assumes unchanged housing wealth in 2001 from the end-2000 level. All other variables assume their actual values.

2/ Fitted values of the error-correction model.

Figure 7. United Kingdom: Dynamic Simulation of Consumption—Shocks to Income, Housing and Financial Wealth, 1998-2001







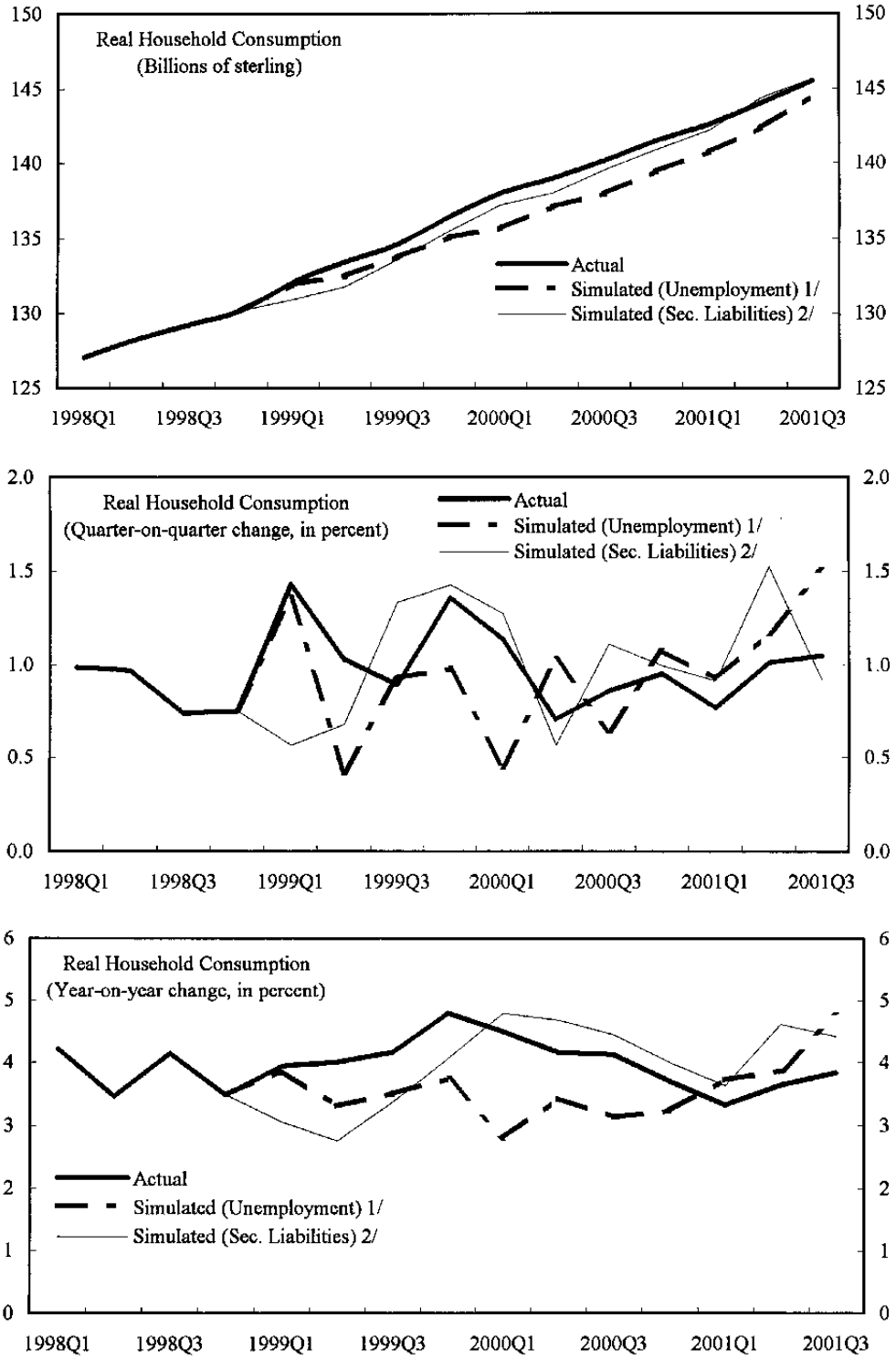
Sources: Bank of England; National Statistics (ONS); and IMF staff estimates.

1/ Assumes a decline in disposable income of 2.6 percent between 1998:Q4 and 1999:Q4, and unchanged values thereafter.

2/ Assumes a decline in housing wealth of 8.9 percent between 1998:Q4 and 1999:Q4, and unchanged values thereafter.

3/ Assumes a decline in financial wealth of 11.4 percent between 1998:Q4 and 1999:Q4, and unchanged values thereafter.

Figure 8. United Kingdom: Dynamic Simulation of Consumption—Shocks to Unemployment and Secured Liabilities, 1998-2001



Sources: Bank of England; National Statistics (ONS); and IMF staff estimates.

1/ Assumes an increase in the unemployment rate of 2.3 percentage points between 1998:Q4 and 1999:Q4, and unchanged values thereafter.

2/ Assumes a decline in the stock of secured liabilities of 2.4 percent between 1998:Q4 and 1999:Q4, and unchanged values thereafter.

substantial consumption smoothing, characteristic of an economy with relatively few liquidity-constrained individuals.[16]

- **Consumer confidence variables (specifically the unemployment rate) seem to play an important role in explaining the short-run dynamics of consumption:** the estimated coefficient implies that, if unemployment were to rise from its current level of about 5 percent by half a percentage point to 5.5 percent within a quarter (a 10 percent increase), the immediate impact on quarter-on-quarter consumption growth would be a decline of roughly 0.4 percentage points.[17]

- **The boost to consumption from the availability of credit secured on dwellings appears to be strong but short lived.** The immediate impact on consumption of changes in secured household liabilities is positive (positive coefficient of contemporaneous secured liabilities), but the reversion to long-run behavior begins after one quarter (negative coefficient of lagged secured liabilities).[18]

- **The combined short-run sensitivity of consumption to net housing wealth is much larger than that of net financial wealth.** [19] This seems to suggest that households tend to regard recent gains in housing wealth as more permanent than those in financial wealth (mainly stock market gains).

- **The adjustment of consumption to deviations from the long-run equilibrium is relatively slow, pointing, once again, to considerable consumption smoothing:** the coefficient of the error correction term suggests that it takes roughly 7 to 8 quarters for household consumption to fully respond to a shock and reach its new equilibrium. The dynamic simulations confirmed this pattern.

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[16] See Deaton (1992), Chapter 7.

[17] This result is based on a partial analysis, which does not allow for the impact of an increase in unemployment on the other variables. In addition, it applies only to small changes.

[18] Boone *et al* (2001), using different methodology and semi-annual data, also found a positive association of contemporaneous equity withdrawal and consumption in the United Kingdom.

[19] The dynamic equation estimated by the Bank of England, though different in the variables included and in their definition, broadly confirms this result. The result is also consistent with other empirical work. See, for example, Boone *et al* (2001) and Ludwig and Sløk (2002) who used data on OECD countries.

- **The estimated coefficients of the model exhibit remarkable stability throughout the sample.** This suggests that the influence of housing wealth and secured borrowing by households has not risen in recent years and that their contribution to the recent strength of consumption reflects their rising levels rather than an increase in the sensitivity of consumption to these factors.

- **The initial response of consumption to a change in disposable income is slow** (reflecting smoothing), but gathers momentum as consumers increasingly realize that the income change is permanent rather than temporary. The dynamic simulations suggest that, over the long run, consumption is primarily responsive to changes in disposable income, and to a lesser extent, housing wealth. In the short run, changes in housing wealth and unemployment (and to a lesser extent secured liabilities) appear to be important factors.

- **Consumption growth should prove quite resilient to modest shocks stemming from asset price declines.** Consumption grew robustly in 2001 despite the fall in equity prices, and simulations suggest that, while consumption growth that year was bolstered by the increase in housing wealth, much of its strength reflected the underlying gains in disposable income. However, a major decline in house prices could potentially have a significant impact on consumption in the short run, but the effect would be mitigated somewhat over the long run once consumption reaches its new, lower equilibrium. A roughly 10 percent permanent decline in real housing wealth over a year would moderate quarter-on-quarter consumption growth substantially, but only for a short period, and it would reduce the **level** of consumption by about 1 percent in the long run (based on the estimated long-run elasticity).[20]

F. Concluding Remarks

20. The strength of household consumption in the face of the decline in equity prices and large gains in U.K. housing prices has raised questions about its sustainability. This study aimed to uncover both the short- and the long-run influences on consumption and to assess its prospects. The results are robust, the estimated model has a dynamic structure and appealing economic interpretation, and performs well in explaining the historical data.

21. **The recent strength of consumption reflects to a significant extent cumulated gains in disposable income, and, to a lesser extent the carry-over of wealth effects.** Among wealth effects, housing wealth appears to have a larger influence than financial

[20] Such a shock (the precise simulated shock is a 8.9 percent decline in real housing wealth) would indeed be sharp and a rare event (occurring about once every ten years for a normal distribution).

wealth, primarily in the short run, but the sensitivity of consumption to changes in housing wealth does not appear to have increased in recent years. Borrowing secured on dwellings appears to exert a strong positive influence on consumption in the very short run, but its influence is short-lived and its overall contribution over a longer period becomes negative.

22. **The response of consumption to modest shocks (stemming, for example, from a correction in the housing market) would be relatively modest and gradual.** Nonetheless, major and protracted declines could potentially have a significant impact, especially when accompanied by erosion of confidence.

WHY HAS U.K. HOUSEHOLD CONSUMPTION BEEN SO STRONG?

23. This appendix describes a model of household consumption in the United Kingdom based on quarterly data for 1987:Q4–2001:Q3.

A. Data

24. The following series were used in this study (notation in parentheses):

Consumption (CONS): Total final consumption expenditure of households and non-profit institutions servings households (NPISHs) in 1995 prices; seasonally adjusted.

Income (INCO): Gross disposable income of households and NPISHs in 1995 prices; seasonally adjusted.[21]

Net housing wealth (HOU_W): The difference between total residential assets of households and NPISHs and household and NPISH debt (secured on dwellings) to banks, building societies, and others; divided by the consumption deflator and seasonally adjusted.[22]

Net financial wealth (FIN_W): The difference between total financial assets of households and NPISHs and household and NPISH unsecured debt; divided by the consumption deflator and seasonally adjusted.

Real interest rate: Three-month deposit rate (annualized) deflated by the actual annual inflation rate in the preceding 12 months.

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[21] Gross disposable rather than labor income was used for the following reason. Equations relying on labor income exhibited positive feedback from disequilibrium in the consumption equation (see Appendix, Section C, and Table 2), thereby exhibiting a tendency to develop bubbles in consumption that were contained only through a large negative feedback from disequilibrium in the financial wealth equation. While this produced a statistically stable system, in the sense that bubbles in consumption were eventually contained by sharp falls in financial wealth, the result was counterintuitive, and thus disposable income was used.

[22] Residential assets account for about 90 percent of total physical assets of households in the United Kingdom. The series on residential assets was used for its intuitive appeal since it is easier to associate its movements with developments in the housing market. Nevertheless, the series is available only with annual frequency (so is the total physical wealth series). Consequently, the series was interpolated using information from the Halifax house price index and additions to household net wealth to derive a quarterly series of housing wealth.

Unemployment rate (UNEMP): Unemployment rate (in percent), International Labor Organization definition; seasonally adjusted.

Secured liabilities of households (SEC_LIAB): Total household and NPISH debt (secured on dwellings) to banks, building societies, and others; divided by the consumption deflator and seasonally adjusted.

B. Integration

25. To determine the appropriate estimation procedure, Augmented Dickey-Fuller (ADF) tests for nonstationarity of the above variables were carried out, which showed that each variable is integrated of order one (Table 1). ADF tests (not shown) of the null hypotheses of integration of higher order rejected the null. All variables are thus stationary in first differences, and cointegration analysis among the level variables is required.

Table 1. ADF Statistics Testing for a Unit Root

	Variable				
	cons	inco	hou_w	fin_w	real_int
	ADF(2)	ADF(1)	ADF(4)	ADF(0)	ADF(0)
Ho: I(1)	2.23	-0.12	-1.83	-1.40	-1.88

Note: Critical values are: -2.92 (5 percent level), and -3.56 (1 percent level). Lag length was determined by the choice of the lag with the highest AIC (Akaike Information Criterion) statistic in absolute value.

C. Cointegration

26. The Johansen procedure found evidence of the following long-run relationship between household consumption in the United Kingdom and its fundamental determinants:[23]

$$cons_t = 0.708*inco_t + 0.095*hou\_w_t + 0.100*fin\_w_t - 0.008*real\_int_t \quad (A.1)$$

[23] See Johansen (1988 and 1995). Estimation and testing were carried out in PcGive Professional v10b; see Hendry and Doornik (1999).

All estimated coefficients of the selected vector have the anticipated signs.[24]

27. The estimated relationship in (A.1) was used to test two hypotheses. First, the hypothesis of homogeneity of order one between household consumption, income, and the wealth variables was tested (i.e., the sum of the coefficients of income and the wealth variables is equal to one). The test of the hypothesis yielded the following statistic (p value in square brackets):

χ^2 (1) =1.312 [0.252]

Based on the large (well in excess of 0.05) p value of the statistic, the null hypothesis cannot be rejected, and the restricted long-run relationship becomes:

$$cons_t = 0.854*inco_t + 0.102*hou\_w_t + 0.043*fin\_w_t - 0.006*real\_int_t \quad (A.2)$$

Second, two hypotheses were tested jointly: homogeneity of order one, and equality of the coefficients of the wealth variables. The test of the joint hypothesis yielded the following statistic:

χ^2 (1) =2.885 [0.236]

The joint null hypothesis cannot be rejected, and the following restricted long-run relationship results:

$$cons_t = 0.985*inco_t + 0.015*hou\_w_t + 0.015*fin\_w_t + 0.005*real\_int_t \quad (A.3)$$

28. Although the restricted cointegrating vector in (A.3) cannot be rejected by the data, it is not very appealing for two reasons. First, the coefficient of the real interest rate enters with a counterintuitive positive sign. Second, the coefficient of income is much larger than known empirical estimates of the long-run elasticity of household consumption with respect to income, which are usually in the range 0.8 to 0.9. Consequently, on purely economic grounds, the long-run relationship estimated in (A.2) was the one selected.[25]

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[24] Only one cointegrating vector was uncovered.

[25] The theoretical requirement of homogeneity of order one is more stringent than that of equality between the long-run elasticities of household consumption with respect to net housing wealth and with respect to net financial wealth.

29. Table 2 reports the tests for the presence of cointegrating vectors in the Johansen procedure, as well as the feedback coefficients and their standard errors corresponding to the cointegrating vector in (A.2).

Table 2. Johansen Test of Existence of Long-run Relationships, and Feedback Coefficients 1/

	Trace 2/
Ho: rank=0	74.163 [0.020] *
<=1	43.050 [0.131]
<=2	20.403 [0.407]
<=3	7.8226 [0.492]
<=4	0.0062 [0.937]

	cons	inco	hou_w	fin_w	real_int
Feedback coefficient:	-0.156	0.137	0.713	-0.059	2.885
	(-2.51)	(1.13)	(2.01)	(-0.11)	(0.73)

1/ Standard t-ratios are reported in parentheses. Feedback coefficients represent the response (adjustment) of the respective variable to a deviation of consumption from the long-run equilibrium estimated in (A.2).
2/ Asterisk denotes significant test statistic at the 5 percent level. Based on the trace statistic, the Johansen procedure uncovered a single cointegrating vector, the one in (A.2).

Only the feedback coefficient in the consumption equation is statistically different than zero, suggesting that the single cointegrating vector (A.2) enters only one equation (the consumption equation) in the vector autoregression, and that the adjustments to deviations from equilibrium tend to bring consumption back to equilibrium (negative feedback coefficient).

30. The results of the test for weak exogeneity (i.e., that the feedback coefficients of inco, hou_w, fin_w, and real_int in Table 2 are jointly equal to zero) are the following:[26]

LR test of restrictions: χ^2 (5) = 5.0797 [0.4062]

[26] An additional restriction maintained is that of homogeneity of order one. In essence, this is a joint test of weak exogeneity and homogeneity of order one.

The hypothesis of weak exogeneity of inco, hou_w, fin_w, and real_int cannot be rejected. Thus, a more parsimonious single-equation estimation could be used without any loss of information about the cointegrating vector.

D. Single-equation Modeling (Error Correction)

31. This section introduces the long-run dynamics established in (A.2) into a single-equation, conditional, and parsimonious model for U.K. household consumption that encompasses both short- and long-run dynamics. The short-run dynamics are derived from the following vector of changes in the log-levels of the variables used so far in the analysis:

$I_s = \{\Delta v_{t-j}\}; j = 0, 1\ldots$

where v_{t-j} is the vector of all variables (contemporaneous and lagged) used so far, with the addition of two new stationary variables, orthogonal to the existing regressors. These are:

UNEMP = Unemployment rate
SEC_LIAB = Loans to households secured on dwellings (in constant prices and seasonally adjusted).

32. An error correction model for household consumption in the United Kingdom was estimated using quarterly data over 1988:Q1–2001:Q3.[27] Estimation began from a general specification with several variables and lags, which also included the vector I_s and the deviations of consumption from the long-run relationship (A.2) established above. Subsequently, parameter tests were performed (mostly zero restrictions) to reduce the model to a more manageable form. Below is the resulting specification for household consumption and the relevant statistics (t-ratios are shown in parentheses below the estimated coefficients) and diagnostic tests (p values are shown in brackets next to the estimated statistics):

[27] The first observation (i.e., 1987:Q4) was discarded because it was an outlier: the financial wealth variable was considerably smaller than its trend value reflecting the correction of global equity prices that took place in October 1987.

$$\Delta cons_t = -0.050 - \underset{(-3.05)}{0.043}*\Delta unemp_{t-1} + \underset{(-2.80)}{0.479}*\Delta sec\_liab_t - \underset{(5.15)}{0.420}*\Delta sec\_liab_{t-1} + \underset{(-4.77)}{}$$

$$+ \underset{(5.24)}{0.086}*\Delta hou\_w_t + \underset{(3.23)}{0.052}*\Delta hou\_w_{t-1} + \underset{(2.42)}{0.027}*\Delta fin\_w_t - \underset{(-3.45)}{0.137}*ECM(cons)_{t-1}$$

$R\text{-}BAR^2 = 0.730$, $DW = 2.28$, $\sigma\hat{} = 0.0036$

Autocorrelation tests:		Heteroskedasticity tests:	
AR 1–4 F(4, 43) =	1.385 [0.255]	Xi^2 F(14, 32) =	0.329 [0.985]
AR 1–3 F(3, 41) =	0.610 [0.613]	RESET F(1, 46) =	0.273 [0.604]
AR 1–2 F(2, 43) =	0.208 [0.813]		
AR 1–1 F(1, 45) =	0.301 [0.586]	Normality test:	
ARCH 4 F(4, 39) =	0.636 [0.640]	Non-normality χ^2 (2) =	0.194 [0.908]

33. The estimated equation fits the data well (see lower panel of Figure 3). Moreover, the model passes a battery of diagnostic tests. The hypotheses: of no serial autocorrelation up to fourth order; normality of the residuals; and homoskedasticity could not be rejected. The estimated standard error of the regression (0.0036 or 0.36 percent quarter-on-quarter consumption growth) is relatively low. Finally, the coefficient of determination of 0.73 is relatively high considering that variables are seasonally adjusted and expressed in changes.

34. In addition, the model passes a series of diagnostic tests for misspecification and structural breaks. First, tests for parameter constancy showed that the estimated coefficients are remarkably robust and that their standard errors diminish over time, suggesting correct specification of the estimated model (see Figure 4).[28] The tests suggest that the sensitivity of consumption to housing wealth and secured liabilities has not increased in recent years. Second, a series of diagnostic tests confirmed the absence of structural breaks (see Figure 5). The upper-left panel of Figure 5 shows that the errors of one-period-ahead forecasts are white noise with constant variance. The remaining panels show that, at 1 percent level of confidence, the model does not exhibit any structural breaks at any subset of the period under study, estimated in either ascending or descending chronological order. These tests, too, suggest that the sensitivity of consumption to housing wealth and secured liabilities has not increased in recent years.

[28] The absence of serial correlation was also an indication of correct specification.

35. Tests for the exclusion of relevant variables showed that neither the inflation rate—as proxy for uncertainty and the capital loss to non-indexed financial assets due to inflation—nor an explicit nominal policy interest rate—again as proxy for uncertainty—belong in the dynamic equation for a reasonable number of lags and for the period under study.[29]

[29] Theory prescribes a real interest rate in household consumption functions. However, some empirical models of household consumption in the United Kingdom have found a strong short-run influence on consumption stemming from a nominal interest rate, not necessarily a policy rate (for example, Bank of England, 2000). Presumably, a nominal interest rate captures consumer-confidence factors, which have already been included in the dynamic equation estimated above.

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III. The Rise of the Sterling Real Exchange Rate[1]

A. Introduction

1. The past few years have witnessed a marked appreciation of the United Kingdom's real exchange rate (RER), most notably against the euro-area countries, but also in trade-weighted effective terms.[2] On the CPI-based measure, sterling rose by some 30 percent between mid-1996 and end-2001, while the increase in relative unit labor costs, at almost 40 percent, was even more spectacular.[3] Yet, during this period, the current account deficit—which widened from 1 percent of GDP in 1996 to about 2 percent of GDP in 1999/2000 (before narrowing to 1.3 percent of GDP in 2001, partly for cyclical reasons[4])—has been perhaps surprisingly modest. More formally, a "macroeconomic balances" approach suggests that only a relatively moderate real depreciation would be required to bring the saving-investment balance closer to its historical norm.[5] As such, irrespective of the original causes of the real exchange appreciation, the *equilibrium* real exchange rate may have increased as well, making a sudden reversal of the RER less likely. This paper explores alternative theories that could account for an appreciation of the equilibrium RER.

2. The first explanation relies on downward sloping demand curves for countries' exports. According to this theory, since growth of manufacturing productivity in the United Kingdom has been outstripped by productivity growth in the U.K.'s main trading partners, the fall in the relative supply of U.K. goods implies that their relative price can rise—that is, the equilibrium RER can appreciate. As a simple test of this theory, a cointegrating relationship between the RER and productivity differentials is used to estimate the "long-run" equilibrium real exchange rate, which indeed shows a substantial increase in recent years.

3. The second explanation, more difficult to establish econometrically, argues that a higher real exchange rate can be supported by the diversification in recent years of the U.K.'s exports into higher value-added and "knowledge-intensive" goods as well as tradeable

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[1] Prepared by Atish R. Ghosh.

[2] Some implications of the real exchange rate appreciation are discussed in a previous *Selected Issues* paper for the 2000 Article IV Consultation (SM/01/145). See Wadhwani (1999) for a comparison of models explaining the appreciation of sterling; and Barker (2001) on possible implications of the exchange rate for the United Kingdom economy.

[3] Lipschitz and MacDonald (1991) provide a useful discussion on interpreting various indicators of competitiveness.

[4] Projection based on data through the third quarter of 2001; the current account deficit was also smaller because of two "one-off" effects: a change in the accounting of income flow from interest rate swaps, and lower than expected transfers to the EU.

[5] For a description of this methodology, see Isard et al. (2001). For an application of this approach to the United Kingdom, see Church (1999).

(especially financial and business) services. This trend has limited the deterioration of the merchandise trade balance, and helps explain the resillence of the services' balance—in turn making the current account balance and the observed real appreciation more sustainable.

4. The plan of the paper is as follows. Section 2 briefly reviews the developments in the real exchange rate and the external balance over the past few years. Sections 3 and 4 turn to alternative theories that would suggest that the *equilibrium* RER may have increased. Section 5 presents some further evidence on the appreciation of the equilibrium RER by examining the effects of the observed RER appreciation on exports and the manufacturing sector more generally. Section 6 concludes.

B. The Real Exchange Rate and the External Balance—Summary of Developments

5. Starting in mid-1996, sterling began to appreciate in real terms particularly against countries in the euro-area, but also in trade-weighted effective terms; Figure 1. Between mid-1996 and the third quarter of 2001, the CPI-based RER had appreciated by some 30 percent, while relative unit labor costs rose by some 40 percent.

6. A number of explanations have been put forward to account for the rise of the RER. One view is that the real appreciation, which has been mostly vis-à-vis the euro, represents not so much the strength of sterling than weakness of the euro nominal exchange rate.[5] Another view is that an increase in domestic demand resulted in the real exchange rate appreciation. Meredith (2001) develops a model in which a decline in the equity premium spurs higher consumption and investment. The monetary tightening that this higher aggregate demand is assumed to elicit in turn appreciates the real exchange rate. More generally, a demand boom may have contributed to the real exchange rate appreciation by driving up the price of nontradables, especially housing.[6]

7. But while nominal and demand side factors may explain the initial real exchange rate appreciation, they provide a less satisfactory explanation for why the real appreciation has been sustained for more than five years. If the real appreciation represented nothing more than the nominal exchange rate movement, then, over time, it should be offset by inflation

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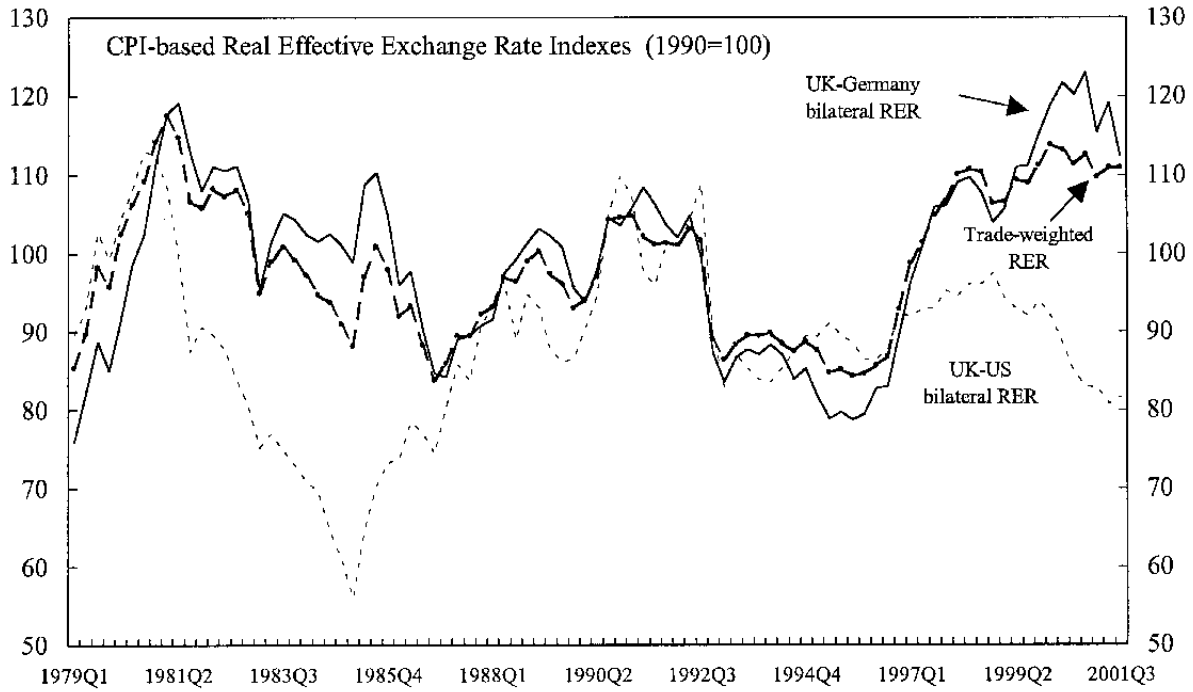
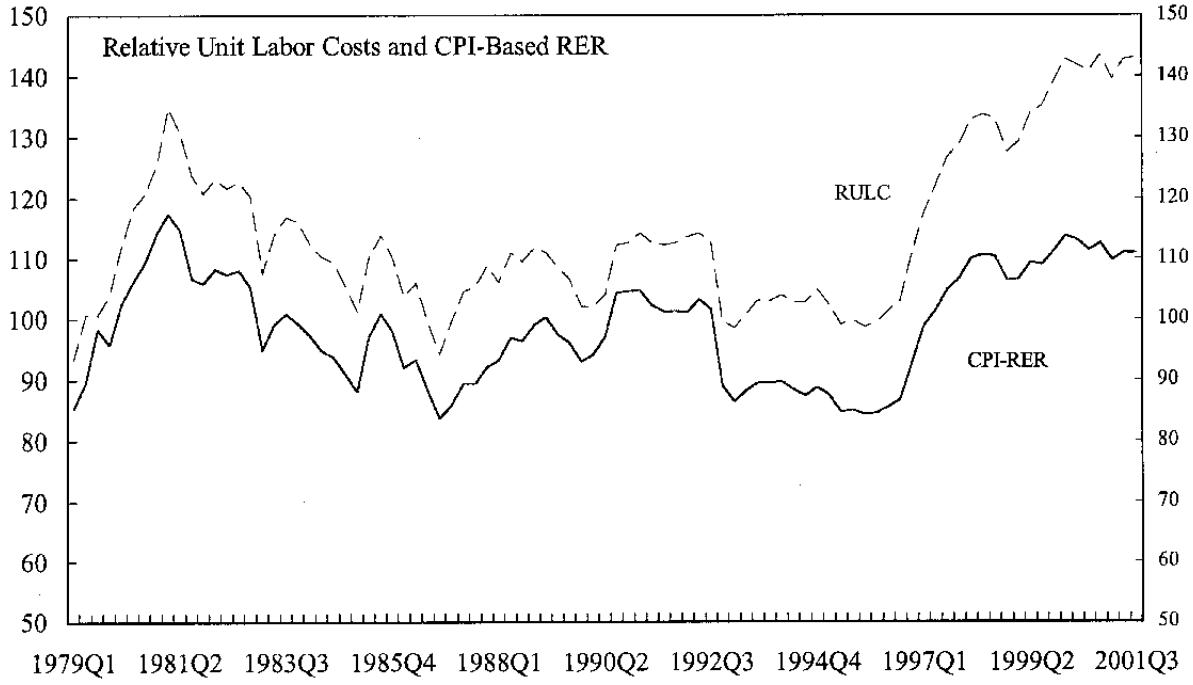
[5] Meredith (2001) explores some of the reasons that the euro nominal exchange rate has been weak.

[6] See *Selected Issues* paper on "Why Has United Kingdom Household Consumption Been So Strong?"

Figure 1. United Kingdom: Real Effective Exchange Rate and Relative Unit Labor Costs





Source: International Monetary Fund, Information Notice System; and International Financial Statistics.

differentials. Likewise, the widening of the interest differential (against Germany and the United States) does, more or less, coincide with the appreciation of sterling between 1996 and 1998, but thereafter the interest rate differential narrowed sharply while the real exchange rate did not depreciate—indeed, it experienced a further (modest) appreciation (Figure 2).

8. Regardless of the reasons for the RER appreciation, it has been associated with a deterioration of the external balance. But the extent of this deterioration has been perhaps surprisingly modest. Between 1996 and 2000, the current account deficit widened from 1.1 percent of GDP to 1.8 percent of GDP, reflecting a deterioration of the trade balance of about 1.4 percent of GDP, partly offset by an improvement in net services exports (0.2 percent of GDP) and higher net income and transfers (0.5 percent of GDP), Figure 3. Moreover, a "macroeconomic balance" approach suggests that only a relatively moderate real depreciation would be required to bring the saving-investment balance closer to its historical norm.

9. In volume terms, growth of exports (excluding oil) slowed abruptly from some 8–9 percent in 1996/97 to less than 2 percent in 1998, but then picked up again in 1999/2000, reaching a very respectable 12 percent per year, (and about 8 percent in the first half of 2001). In addition, the geographical breakdown of the trade balance does not correlate well with the behavior of the real exchange rate. Specifically, the balance with the euro-area countries—against which sterling appreciated most strongly—has actually been improving over the past few years (Figure 4). On the other hand, the trade deficit with non-EU countries has widened by about 2 percent of GDP since end-1997. [8]

10. Taken together, these observations suggest that—irrespective of the original cause of the real appreciation—the *equilibrium* RER may have increased as well. This could explain why the impact on the external balance has been moderate, as well as the persistence of the real appreciation despite the floating exchange rate regime. But why should the equilibrium real exchange rate have appreciated? The remainder of this paper explores two possibilities.

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[8] One explanation is that, in order to cut costs, U.K. firms have started out-sourcing the manufacture of more basic components to other countries, particularly in Eastern Europe and East Asia, while focusing their own production on higher value-added goods. The desire to maintain market share in Europe may also have been a factor, making it difficult to correlate bilateral trade balances to exchange rate movements.

Figure 2. Real Exchange Rate and Nominal Interest Rate Differentials

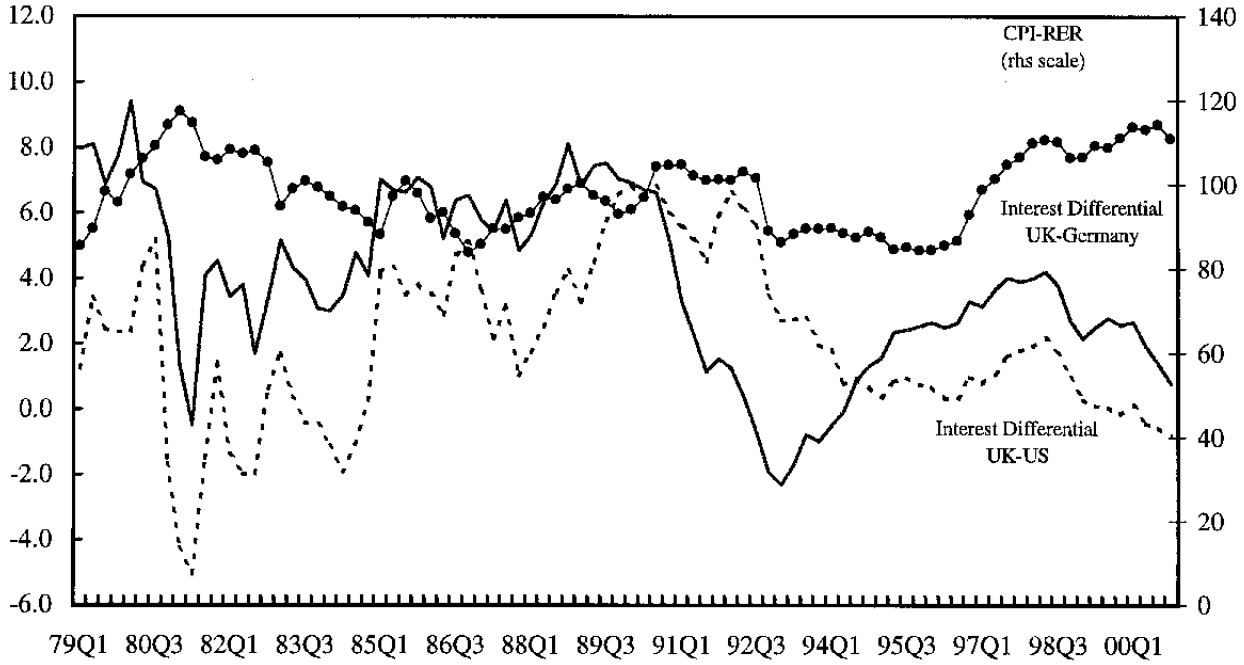
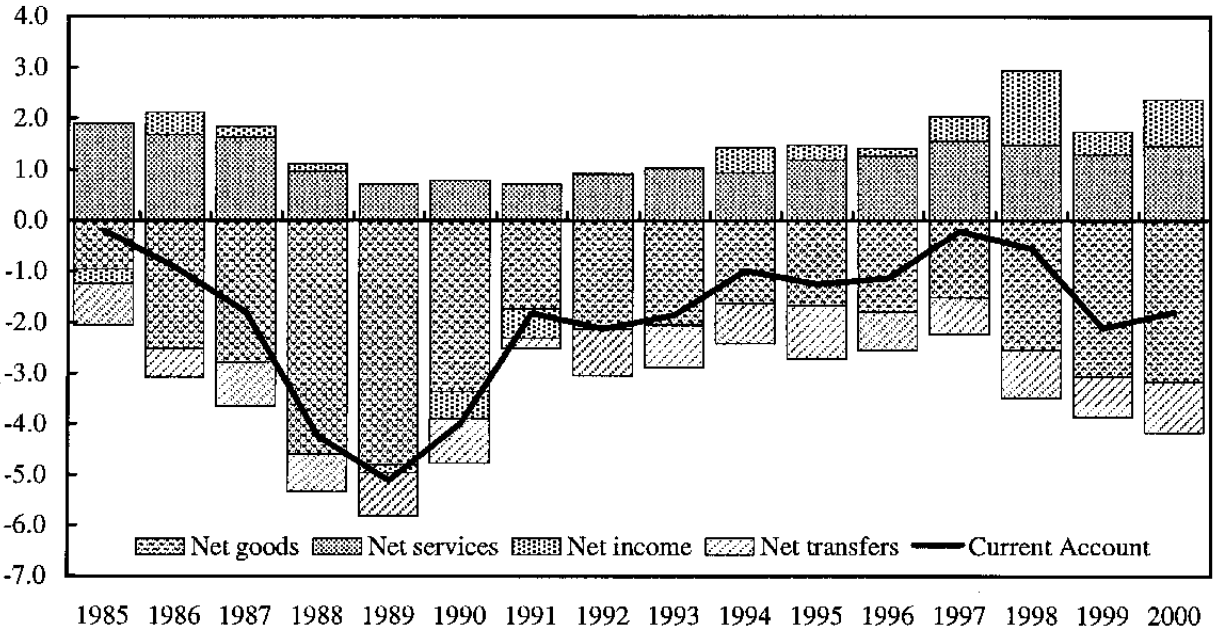
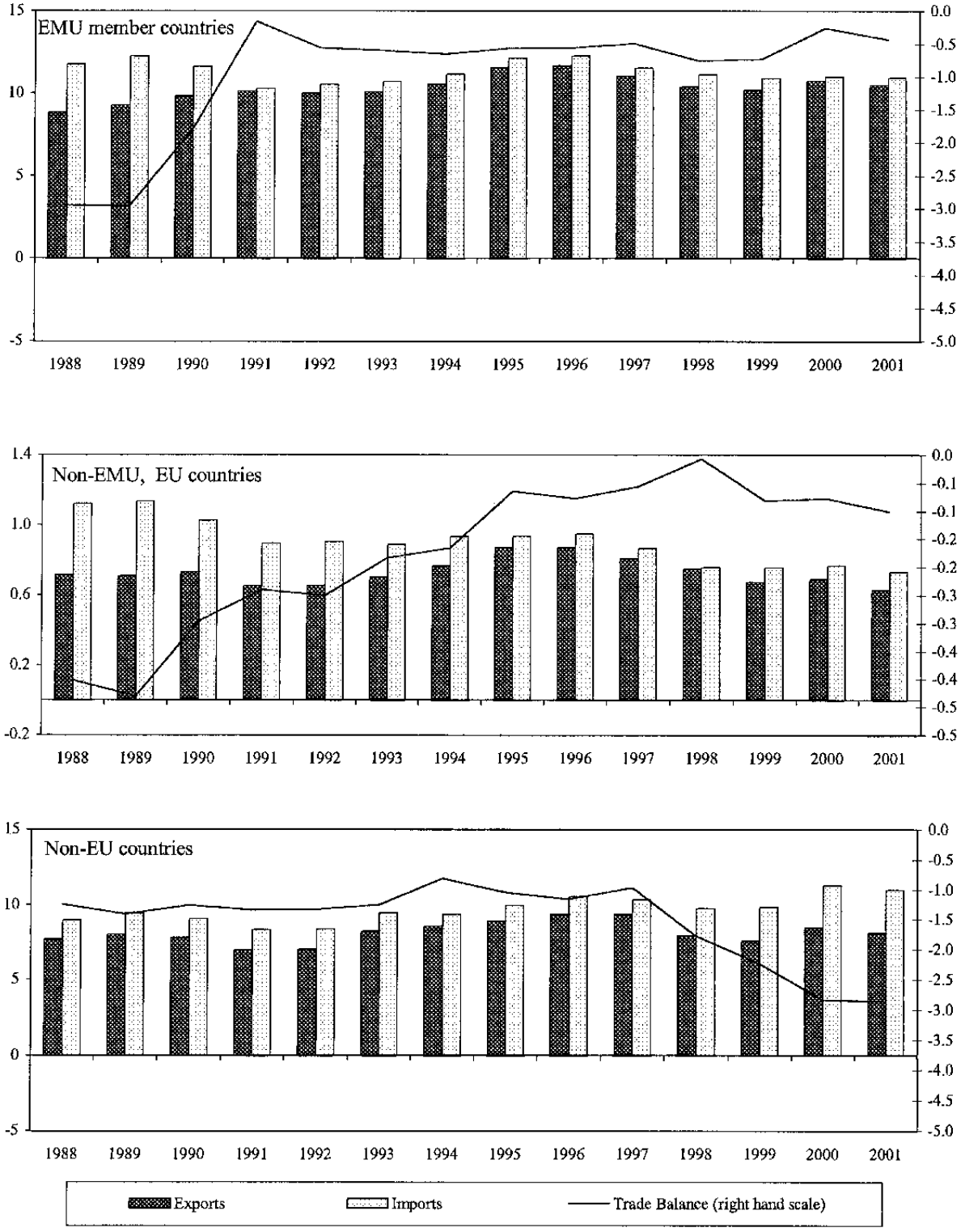


Figure 3. Current Account and Components (in percent of GDP)



Source: International Monetary Fund; and National Statistics.

Figure 4. United Kingdom: Exports, Imports, and Trade Balance:1988-2001
(In percent of GDP)



Source: National Statistics; and IMF staff estimates.

C. Why Has The Equilibrium Real Exchange Rate Appreciated?

Theory

Perhaps the best known model of equilibrium real exchange rate movements is the Balassa-Samuelson effect, whereby faster productivity growth in the tradables sector leads to a rise in the relative price of nontradables, and hence an appreciation of the real exchange rate. However, the ratio of manufacturing/total economy productivity (typically taken as a proxy for tradables/nontradables productivity) has grown more slowly in the United Kingdom than in its partner countries[9]—indeed, the ratio actually declined between 1994 and 1999 (Figure 5, top panel)—so that Balassa-Samuelson effects would suggest a *depreciation* of the equilibrium RER, not an appreciation.

11. The faster growth in manufacturing productivity in the U.K.'s partner countries (Figure 5, bottom panel), however, suggests another channel through which the equilibrium RER may be affected. Under the assumption that countries' exports are imperfect substitutes, standard trade models imply that an increase in supply will require a lower relative price because the demand curve slopes downward. In this theory, therefore, faster productivity growth of manufactures in the U.K.'s trading partners has lowered their relative price, implying an appreciation of the U.K.'s equilibrium RER.[10] In line with this theory, there has indeed been an improvement in the U.K.'s manufacturing terms of trade that mirrors the real exchange rate appreciation (Figure 6), although—as discussed below—the rise in the terms of trade is consistent with alternative theories as well.

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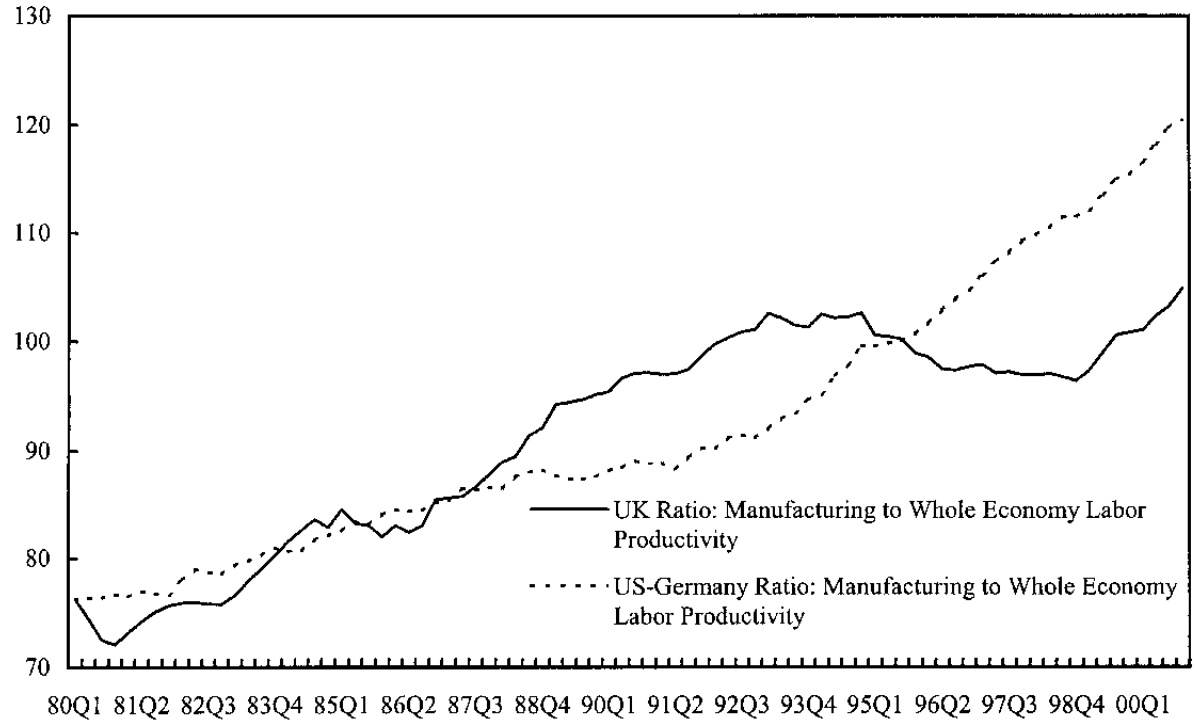
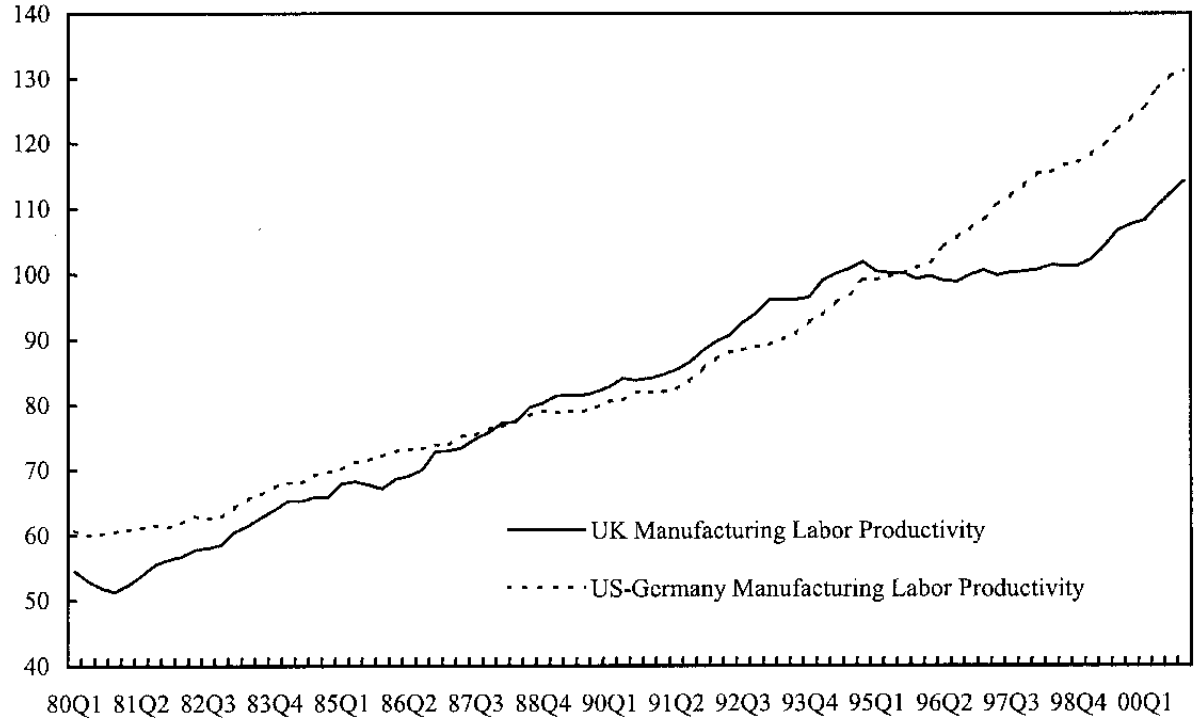
[9] For convenience, the U.K.'s "partner country" is taken to be an unweighted average of the United States and Germany. An alternative would be to construct a trade-weighted measure, in line with the effective exchange rate, although this is not explored in the paper. Productivity measures are the "preferred" measures for each country: output per job filled (United Kingdom), output per person (U.S.), output per hour worked (Germany).

[10] At first blush, it may appear counter-intuitive that faster productivity growth in the tradable sector could depreciate the equilibrium real exchange rate. It bears emphasizing, however, that this mechanism is quite distinct from the Balassa-Samuelson effect, whereby higher productivity growth in the tradables sector relative to the nontradables sector results in a higher price of the nontraded good, and hence an appreciation of the RER. Here, faster productivity growth in the foreign country's exportable sector leads to a fall in its relative price, and hence an appreciation of the home country's equilibrium RER. A recent paper by Søndergaard (2002) provides empirical evidence for such an effect in a panel of OECD countries. Another possibility is that higher productivity growth, by presaging greater wealth, leads to a consumption boom, which to the extent that it falls on nontraded goods, appreciates the RER (through an increase in the price of the nontraded good). While this might explain an appreciation of the actual real exchange rate, it would not necessarily represent an appreciation of the equilibrium RER.

Figure 5. United Kingdom: Manufacturing and Whole Economy Productivity





1/ United Kingdom: Output Per Job Filled; United States: Output Per Person; Germany: Output Per Hour Worked.

Source: National Statistics; US Bureau of Labor Statistics; Deutsche Bundesbank; and Fund staff estimates.

Figure 6. United Kingdom: Manufacturing Terms of Trade and Real Oil Price

Source: National Statistics; and International Monetary Fund.

The Appendix articulates a generic three-good model (nontraded, exportable, and importable good) to identify more formally factors that could affect the equilibrium real exchange rate.[11] The model is characterized by two schedules: internal balance, which requires that output equal expenditure; and (long-run) external balance, which requires that net factor payments on the stock of foreign assets (W) match the trade deficit. The internal balance schedule is upward sloping in the real exchange rate (q) and W space—a higher stock of external wealth raises consumption, so that external demand must be choked off by an appreciation of the real exchange rate. The external balance schedule is also upward sloping in (q,W) space, since a higher stock of external wealth generates greater net factor payments, and can thus support a larger trade deficit and more appreciated real exchange rate (Figure 7, panel (a)).

12. Within this framework, it is straightforward to establish the long-run implications of changes in fiscal policy or changes in productivity (relative to the partner country). An increase in government expenditure requires a jump appreciation of the real exchange rate to maintain internal balance in the face of higher aggregate demand. Since the current account deficit widens, however, over time the stock of net foreign assets declines as does the stream of net factor payments. Over the longer-run, therefore, the equilibrium real exchange rate must depreciate to reduce the trade deficit (Figure 7(b)).[12]

13. Productivity increases in both the traded and nontraded sectors will cause a downward shift of the external balance schedule since, at any given stock of external assets, a more depreciated real exchange rate is required to offset the deterioration of the trade balance arising from the higher income. There will also be a downward shift of the internal balance schedule, since a more depreciated real exchange rate is required to increase aggregate demand to match the higher aggregate supply. The net effect is likely to be a *depreciation* of the real exchange rate in the short-run, and unambiguously so in the long-run (Figure 7c). Finally, an increase in productivity in the tradable sector *relative* to the nontradable sector, shifts both schedules upward, leading to an appreciation of the real exchange rate, essentially due to Balassa-Samuelson effects (Figure 7d).

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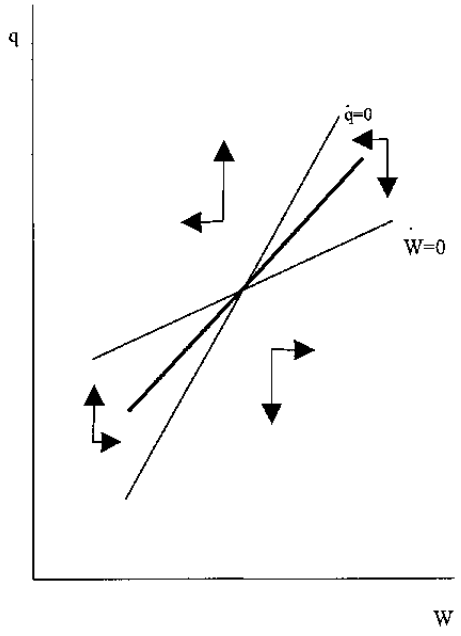
[11] The model draws upon those developed by Alberola et al. (1999), Hansen and Roeger (2000), among others.

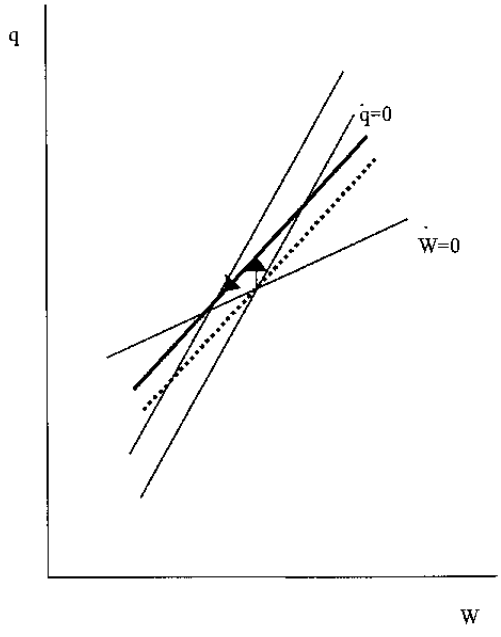
[12] In fact, econometric estimates for the United Kingdom suggest that a fiscal expansion depreciates the real exchange rate even in the short-run; see the *Selected Issues* paper on "The Macroeconomic Effects of United Kingdom Fiscal Policies: An Empirical Exploration."

Figure 7. Response of the Real Exchange Rate to Alternative Shocks 1/

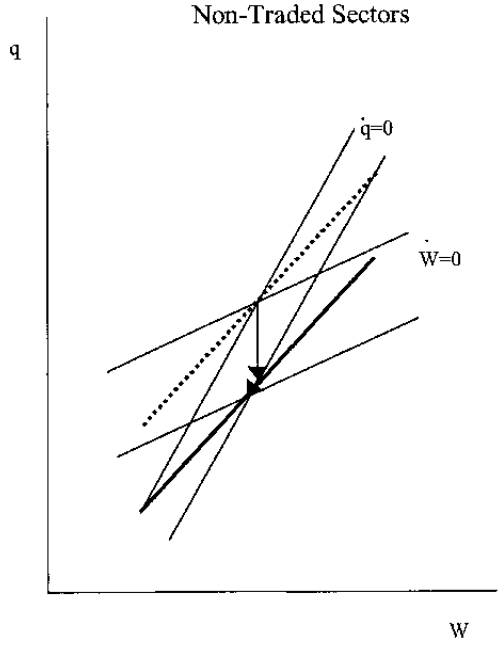
Internal and External Equilibrium



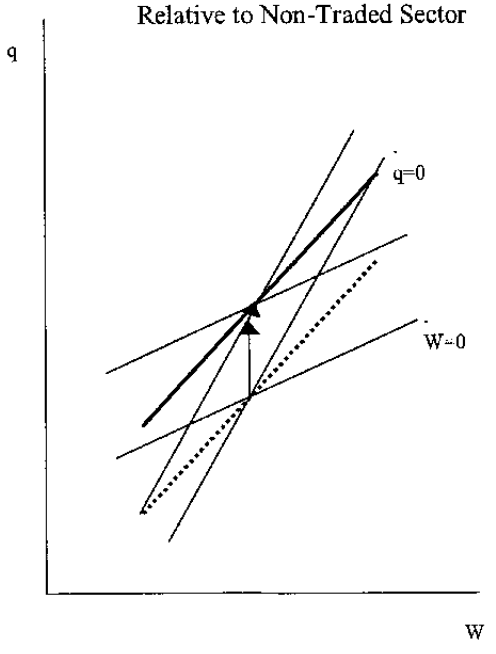
Increase in Government Expenditure



Increase in Productivity in Both Traded and Non-Traded Sectors



Increase in Productivity in Traded Sector Relative to Non-Traded Sector



q: real exchange rate (increase is an appreciation)
W: stock of foreign assets
Pre-shock saddle path: .....
Post-shock saddle path: ———

Empirical estimates

14. As outlined above, the theoretical model has certain implications for the effects of fiscal policy and productivity growth differentials on the equilibrium RER.[13] To test these implications a co-integrating relationship for the real exchange rate is specified. If a co-integrating relationship exists, it is natural to identify it with the long-run equilibrium real exchange rate. The estimated relationship can then be used directly to establish whether the equilibrium RER has indeed appreciated.[14]

15. Two variants of the model are estimated. The first uses the differential between the United Kingdom and its trading partners (an average of the United States and Germany) of the government balance, productivity in the traded goods sector (proxied by the manufacturing sector), and the ratio of productivity in traded/nontraded goods (proxied by the ratio of productivities in manufacturing and the whole economy). The second variant of the model augments this vector with the terms of trade, real oil prices, and the real long interest rate differential.[15] It is not clear, however, that the terms of trade is a legitimate variable for explaining the real exchange rate movement. If, contrary to the assumption of the model, the United Kingdom were small in the world market for its exports, the terms of trade could be treated as exogenous and might help explain the real exchange rate dynamics. But if, as seems likely, the United Kingdom has at least some market power in its exports of manufactures, then the terms of trade will not be exogenous, and there is a risk of circularity in using the terms of trade to explain movements of the real exchange rate.

16. Table 1 presents standard augmented Dickey-Fuller (ADF) statistics. Once significant lags are included, the ADF statistics cannot reject a unit root in any of the variables; as such co-integration techniques are appropriate.

17. Table 2 presents the relevant Johansen statistics for each model. In each case, the Johansen technique finds a single co-integrating vector (except when the real interest differential—which is probably borderline stationary itself—is included), suggesting that the

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[13] What follows is not a full test of the theoretical model. Such a test would require specifying the dynamics toward the long-run equilibrium, as well as the inclusion of other variables such as the stock of external wealth. The net international investment position (in percent of GDP) can be included in the cointegrating vector (estimated below), but in practice it makes only a marginal explanatory contribution and little difference to the other coefficient estimates.

[14] See MacDonald (1997) for a similar approach.

[15] All variables are in logarithms, except the government balance differential (percent of GDP) and the interest rate differential (percent per year).

Table 1. Augmented Dickey-Fuller Statistics

	t-ADF 1/
Real exchange rate 2/	-2.58
Oil price 3/	-2.37
Terms of trade 4/	-3.03
Manufacturing Productivity 5/	-1.33
Government balance 6/	-2.23
Ratio Manufacturing/Whole economy Productivity 7/	-0.86
Real interest rate 8/	-2.20
Residual from cointegrating vector, Model 1	-4.22 **
Residual from cointegrating vector, Model 2	-3.58 *

Source: Author's calculations.

1/ ADF t-statistic with constant and trend included;
critical values: 5 percent (*) -3.467; 1 percent (**) -4.079.
2/ CPI-based real exchange rate (log)
3/ Brent crude oil price (log)
4/ U.K. manufacturing terms of trade (log)
5/ U.K. Output per job, manufacturing industries;
U.S.: Output per person manufacturing industries;
Germany: Output per hour worked manufacturing industries;
6/ U.K. Government total net borrowing;
government deficit (Germany, United States); percent of GDP, differential.
7/ U.K.: Output per job filled, ratio manufacturing industries/whole economy;
U.S.: Output per person manufacturing industries/whole economy ;
Germany: Output per hour worked manufacturing industries/whole economy;
log differential of indices.
8/ Long-term bond yield deflated by average consumer price inflation
(year t+1,t-1), differential, in percent per year.
Data sources: U.K. Office of National statistics; United States
Bureau of Labor Statistics; Deutsche Bundesbank; and International Monetary Fund.

Table 2. Johansen Statistics

Ho:rank = ρ	-Tlog(1-μ)	using T-nm	95% critical level	-T\Sum log(.)	using T-nm	95% critical level
			Model 1 1/			
ρ == 0	31.73 *	30.20 *	27.10	50.63 *	48.19 *	47.20
ρ <= 1	9.79	9.31	21.00	18.90	17.99	29.70
ρ <= 2	8.96	8.53	14.10	9.12	8.68	15.40
ρ <= 3	0.15	0.14	3.80	0.15	0.14	3.80
			Model 2 2/			
ρ == 0	50.64 **	47.59 **	33.50	96.58 **	90.76 **	68.50
ρ <= 1	27.61 *	25.95	27.10	45.94	43.17	47.20
ρ <= 2	11.91	11.19	21.00	18.33	17.23	29.70
ρ <= 3	6.27	5.89	14.10	6.42	6.04	15.40
ρ <= 4	0.15	0.14	3.80	0.15	0.14	3.80
			Model 2 3/			
ρ == 0	58.73 **	54.48 **	39.40	137.10 **	127.10 **	94.20
ρ <= 1	36.45 *	33.82 *	33.50	78.32 **	72.66 *	68.50
ρ <= 2	21.49	19.94	27.10	41.87	38.84	47.20
ρ <= 3	13.18	12.23	21.00	20.37	18.90	29.70
ρ <= 4	7.11	6.60	14.10	7.19	6.67	15.40
ρ <= 5	0.08	0.07	3.80	0.08	0.07	3.80

Source: Author's calculations.

1/ Model 1: Manufacturing productivity, Manufacturing/Whole economy productivity, Government balance.

2/ Model 2: Manufacturing productivity, Manufacturing/Whole economy productivity, Government balance, Manufacturing terms of trade, Real oil prices

3/ Same as Model 2, but adds real interest rate differential.

procedure has low power. But the co-integrating vectors, reported in Table 3, accord with the theoretical model: an improvement in the fiscal balance is associated with an appreciation of the (long-run) real exchange rate, as is an increase in the ratio of traded/nontraded productivity; an increase in productivity in traded goods sector (holding constant the traded/nontraded productivity ratio) is associated with a long-run real depreciation. In the augmented model, a terms of trade improvement is associated with a real appreciation as is an increase in real oil prices, while an increase in the real interest rate differential has a marginally negative effect.

Figure 8 plots the actual and estimated equilibrium RERs for the two models. A number of points are noteworthy. First, the actual and equilibrium RERs generally track quite closely. Second, the equilibrium RER shows a substantial appreciation starting in mid-1996 so that, at end-2000, the actual RER was only slightly above the estimated equilibrium RER. Third, given that the ability of the two models to track the real exchange rate is roughly equal, the additional variables included in the second model do not appear to contribute much to the explanatory power. Indeed, a decomposition of the co-integrating vectors into theirTable 1 components shows that, in the first model, the bulk of the movement is accounted for by shifts in productivity (with the improvement in the fiscal balance making a minor contribution), while in the second model, it is again mostly shifts in productivity and the terms of trade that matter (Figure 9). Finally, it is noteworthy that between 1990 and 1992 (the eve of the ERM crisis) the RER was substantially above its estimated equilibrium level.

18. To summarize, theory implies that if countries face downward-sloping demand curves for their exports, a decrease in relative productivity in the tradables sector will be associated with a higher price—that is, a real exchange rate appreciation. Estimates based on a parsimonious co-integrating vector suggest that the equilibrium RER has indeed appreciated.

D. Alternative Explanations

19. An alternative explanation for why the equilibrium RER may have appreciated does not rely on a downward-sloping demand curve for aggregate exports.[16] Rather, it suggests that a shift toward higher value-added exports in recent years has resulted in an improvement in the terms of trade and an appreciation of the equilibrium RER. [17]

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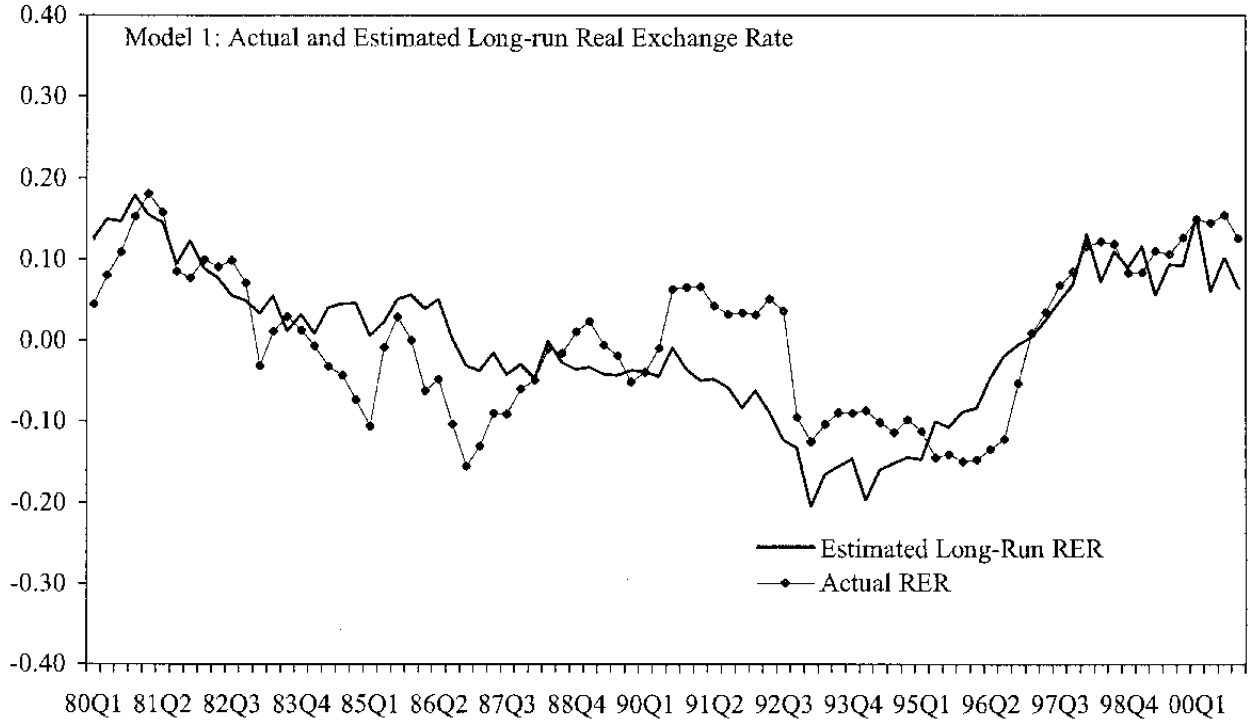
[16] Indeed, Krugman (1989) argues that countries need not experience a real depreciation even if their export growth rate is higher than that of their partner countries. In his model, the expansion of exports takes the form of the production of new varieties for which there is corresponding demand. The alternative explanation for the appreciation of the United Kingdom equilibrium RER presented here is in the spirit of this model, though the specific details differ.

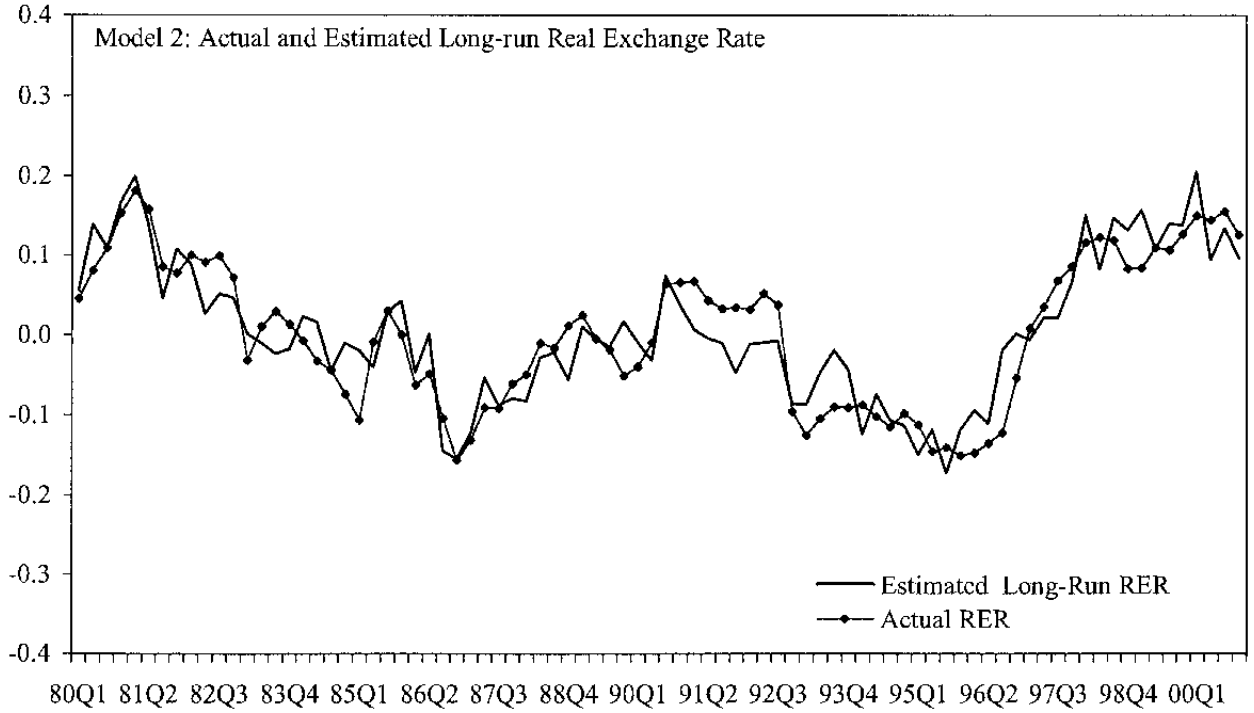
[17] It is an open question whether this shift is a response of the economy to the real exchange rate appreciation, or whether it reflects underlying technologically-drive trends that are independent of the exchange rate.

Table 3. Implied Long-run Equilibrium Real Exchange Rate Vector

	Model 1		Model 2	
	Coefficient	Standard error	Coefficient	Standard error
Government balance	1.07	0.66	1.42	0.37
Manufacturing Productivity	-2.01	0.61	-1.84	0.50
Ratio Manufacturing/Whole economy Productivity	0.86	0.55	1.10	0.42
Oil price	...	...	0.07	0.03
Terms of trade	...	...	2.21	0.36
Real interest rate	...	...	-0.01	0.01

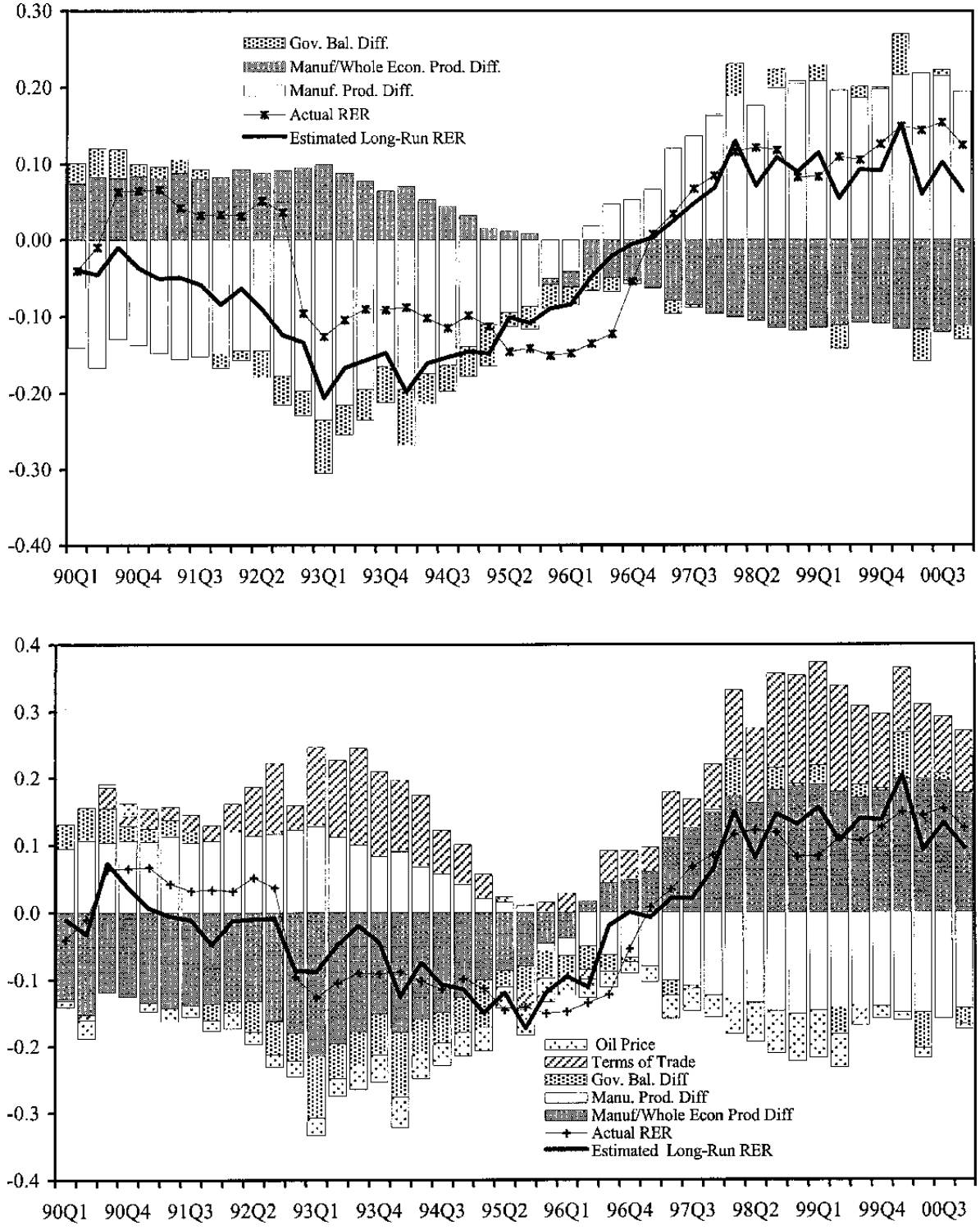
Figure 8. Actual and Estimated Long-run Real Exchange Rate





Source: Author's calculations.

Figure 9. United Kingdom: Decomposition of Estimated Equilibrium Real Exchange Rate



Source: Author's calculations.

20. Why would this shift to higher value-added exports not be reflected in the productivity data? Traditional manufacturing productivity measures may not be able to capture price and quality increase as the product mix shifts, and of course completely ignore the services sector—yet the United Kingdom has seen a marked expansion of "tradable" services, most notably the financial and business services sector.

Is there any evidence in support of this view? While direct evidence is difficult to obtain, there are a few indicators. First, over the past few years, many low value-added manufactured exports—food, beverages, clothing—have had sluggish or no growth, while exports of chemicals, machinery and transport equipment, and scientific and photographic equipment have enjoyed robust growth (Figure 10). Second, after a sharp fall in 1998, profitability of manufacturing firms has been recovering (until the recent cyclical downturn) (Figure 11). Indeed, net rates of return were comparable to levels seen in 1994–95 (prior to the sharp appreciation) and higher than levels in the late 1980s (before the United Kingdom joined the ERM). Third, crude measures of the "knowledge-content" of products suggest that U.K. exports rank among the highest in the G-7, and have been increasing over time (Figure 12). Finally, there has been an expansion of the business, communications, and financial services sectors. Overall, these indicators suggest that there has been a shift toward tradable services and higher value-added exports, which would imply an appreciation of the equilibrium RER, though it is not possible to quantify by how much.

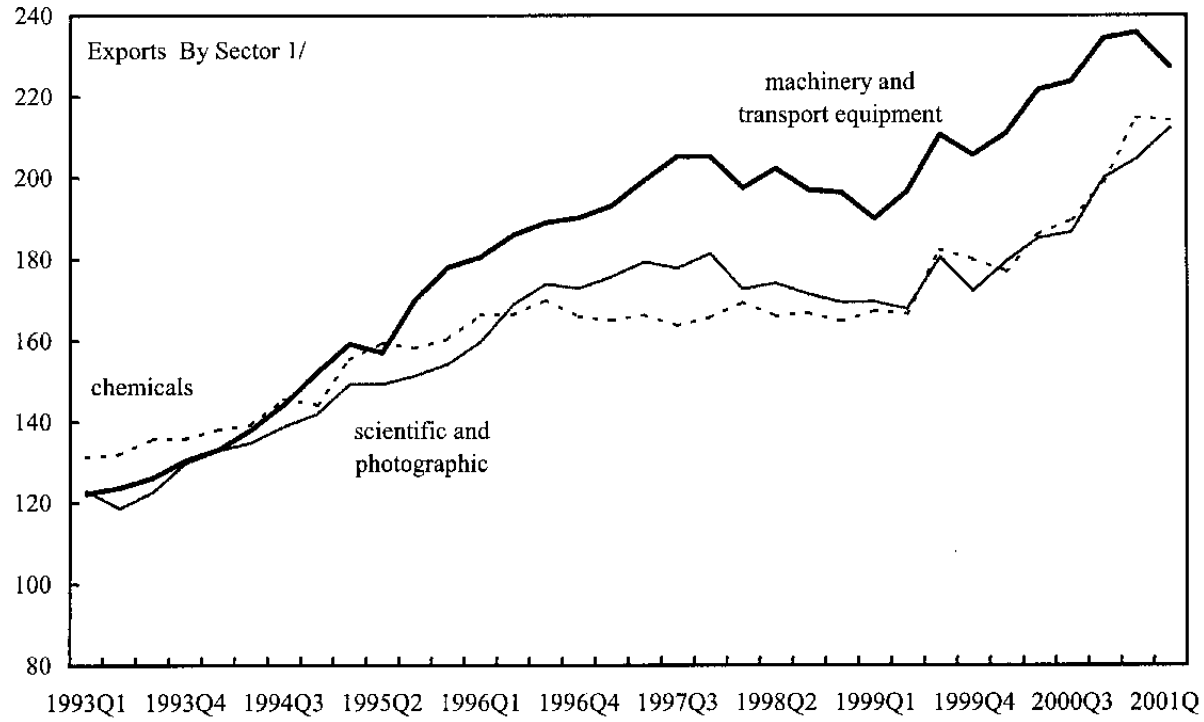
E. Further Evidence on the Equilibrium Real Exchange Rate Appreciation

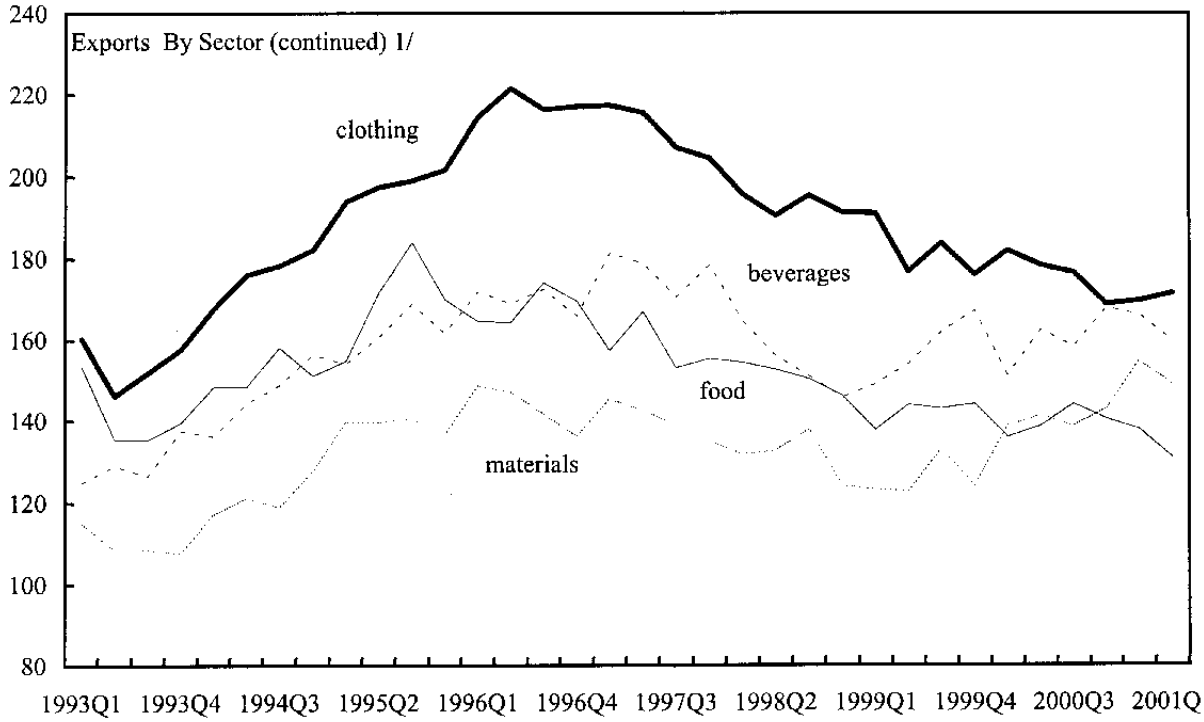
21. Taken as a whole, the evidence above suggests that the U.K.'s equilibrium RER may have appreciated in recent years.[18] Beyond such purely statistical concepts of equilibrium, however, the RER may be considered close to equilibrium if it does not lead to an unsustainable external deficit. As noted in Section B, to date the impact on the trade balance seems to have been relatively moderate. But does this simply reflect lags in the effects of the real exchange rate appreciation on exports? If so—and if the lagged effects were sufficiently large—it could undermine an assessment that the equilibrium RER has appreciated. This section therefore bolsters the analysis by examining whether the effects of the observed real exchange rate appreciation have completely fed through to the economy.

22. Thus far, the real appreciation has lasted more than five years, so presumably much of the effects on production decisions should have been manifested already. On the other hand, inasmuch as the real appreciation affects investment decisions, there may be substantial gestation lags. Since these are difficult to pin down, the focus here is simply on the impact on exports and the share of manufacturing in the economy.

[18] For a similar conclusion, see Barrie and Jukes (2001).

Figure 10. United Kingdom: Export Growth by Sector





Source: National Statistics.
1/ Value index, 1990Q1=100

Figure 11. United Kingdom: Net Rates of Return of Private Non-Financial Corporations
(in percent per year)

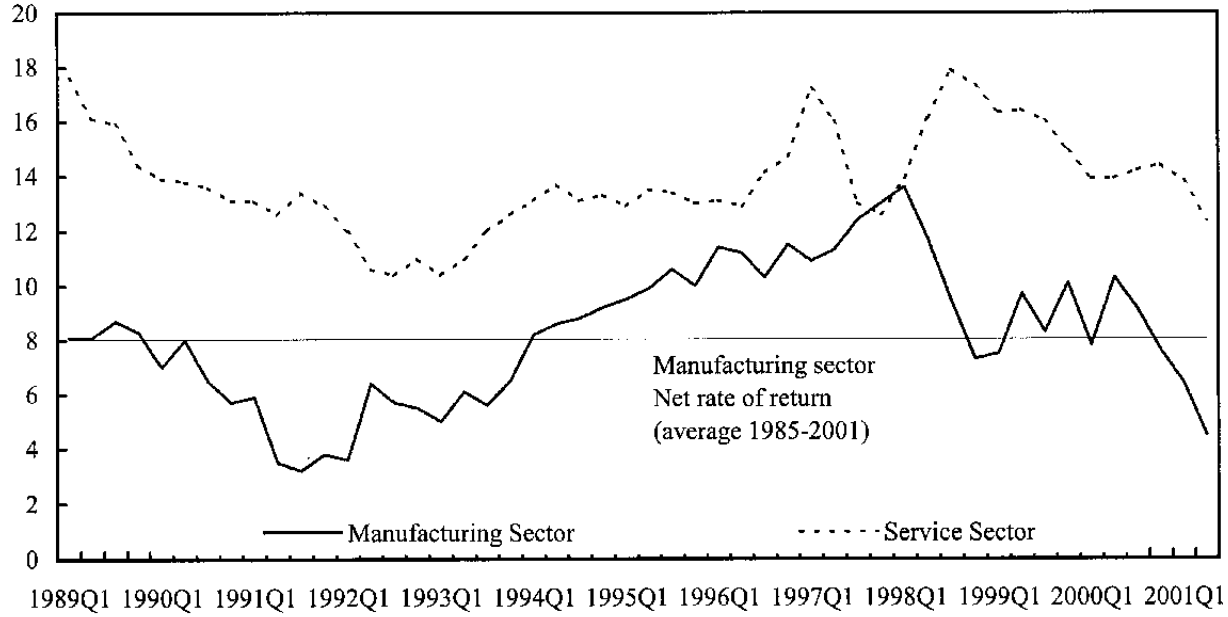
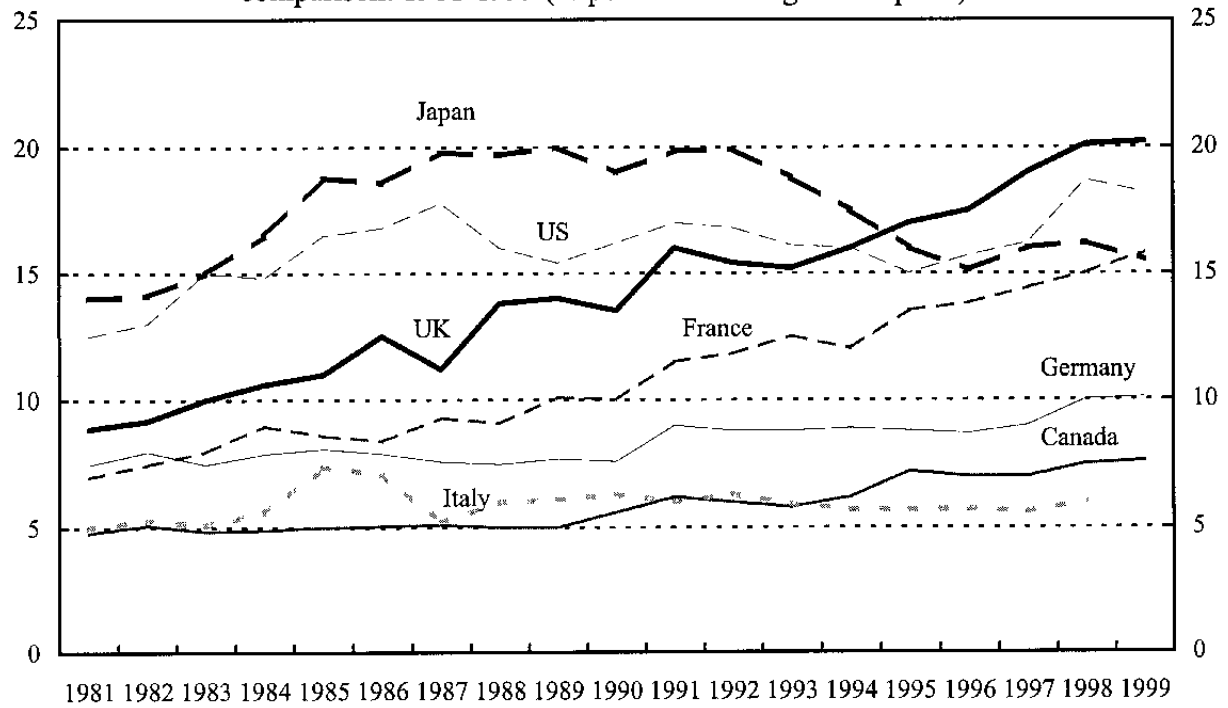


Figure 12. United Kingdom: Exports of high and medium technology goods, G7 comparison: 1981-1999 (In percent of total goods exports)



Source: National Statistics.

23. Figure 13 relates the actual log level of the volume of exports to its long-run co-integrating vector, where the latter depends on activity in the partner countries (Germany, the United States, and Ireland) and the real exchange rate.[19] The actual value of exports, as of 2000, is very close to the value implied by the co-integrating relation, suggesting that—barring any further real appreciation—most of the effect on exports has already been observed.

Figure 14 undertakes a similar exercise for the share of manufacturing in total value added, which is related to the real exchange rate and a time trend. There has been a secular Figure13 share of manufacturing is about ½ percentage point above the implied long-run value, suggesting that the full effects of the real appreciation to date are likely to entail a further (albeit modest) decline in the share of manufacturing in the United Kingdom economy.

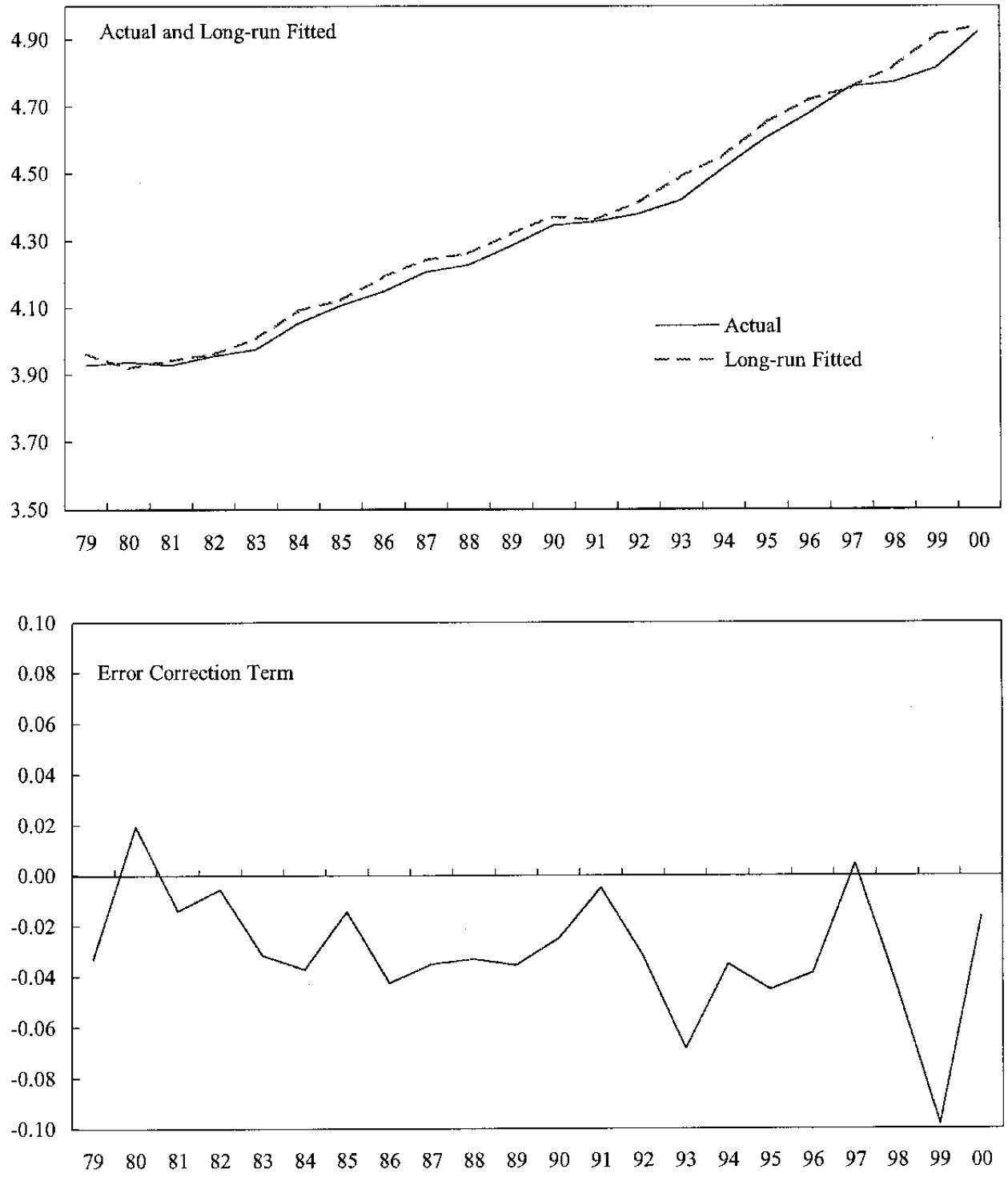
F. Conclusions

24. The persistence of the real exchange rate appreciation observed in the United Kingdom over the past few years (despite the floating exchange rate regime) suggests that the *equilibrium* RER may have appreciated as well. This paper has explored two alternative theories for why the equilibrium RER could have appreciated. The first theory focuses on the price effects of productivity differentials across countries. The second explanation is based on the shift toward higher value-added exports and tradable services. In practice, both factors are likely to have been at play.

25. The assessment that the equilibrium RER has appreciated is bolstered by the relatively moderate impact on the external balance of the observed real exchange rate appreciation. Moreover, simple econometric exercises suggest that much of the effect of the RER appreciation on exports has already been realized, and while there may be further effects on the manufacturing sector more generally, they are unlikely to be terribly large.

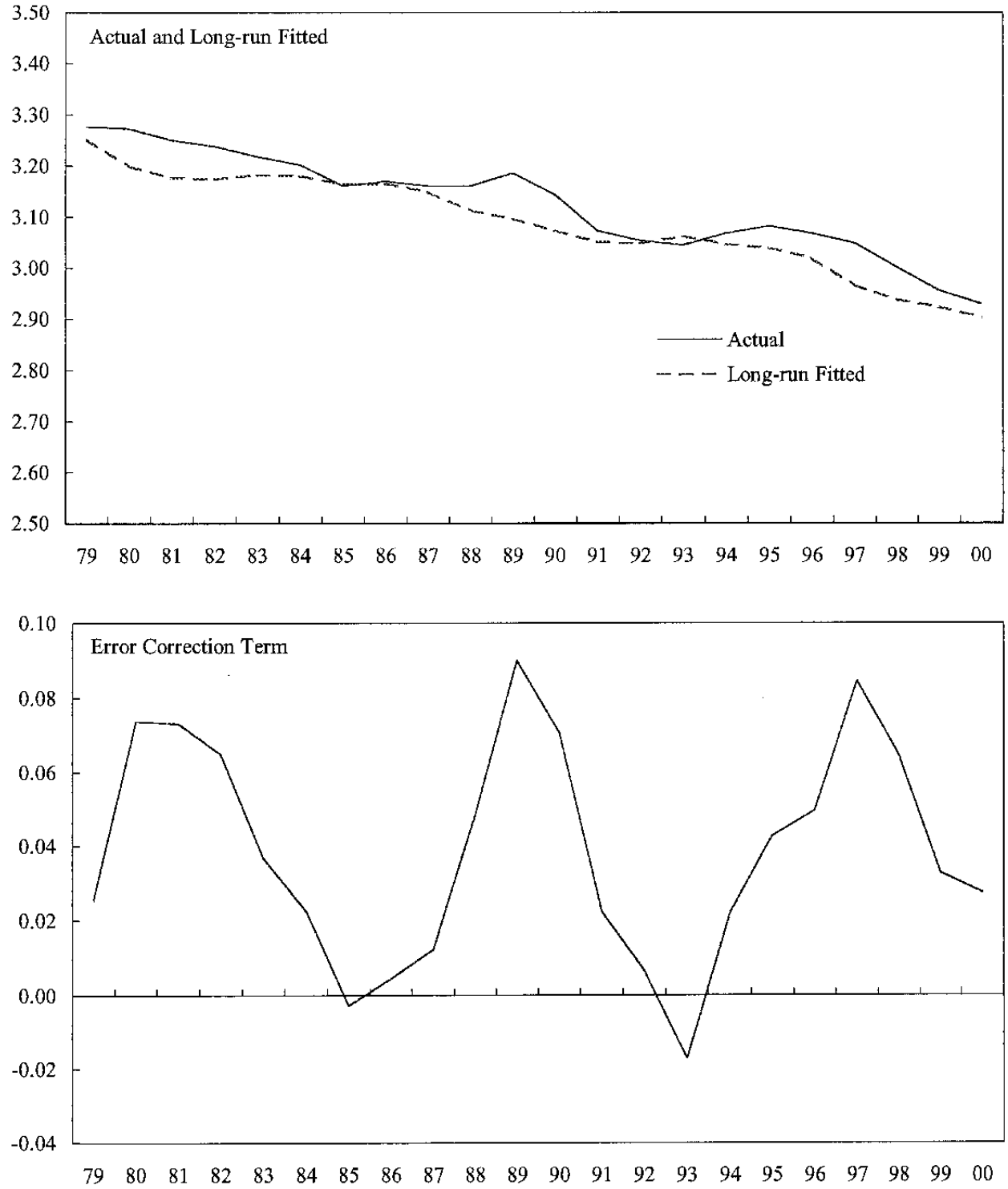
[19] The activity elasticities are around 0.5, while the real exchange rate elasticity is about—0.4. The ADF t-statistic on the residual from the cointegrating relation is -4.5.

Figure 13. United Kingdom: Exports--Actual and Long-run Fitted (1979-2000)
(volume, in logarithms)



Source: Author's calculations.

Figure14. United Kingdom: Share of Manufacturing in Total Gross Value Added--
Actual and Long-run Fitted (1979-2000) 1/



Source: Author's calculations.
1/ In logarithms.

A THEORETICAL MODEL OF REAL EXCHANGE RATE DETERMINATION

26. This Appendix outlines a three good (non-traded, exportable, importable) model of real exchange rate determination.

A. Production

27. The home country uses labor to produce a nontraded good (N) and an exportable good (T). Since labor is mobile, the marginal product of labor will be equated across sectors. Let Θ denote labor productivity, then assuming flexible prices, the price of nontraded good relative to the home country (Q^N) depends on relative productivity of the traded good:

$$P^T\Theta^T = P^N\Theta^N \Rightarrow P^N/P^T = \Theta^T/\Theta^N \tag{1}$$

Or, taking logarithms:

$$p^N - p^T = \theta^T - \theta^N \tag{2}$$

28. Using the envelope theorem, the value of output in terms of the home country's exportable may be written:

$$Y = Y^T(\Theta^T) + (\Theta^T/\Theta^N)Y^N(\Theta^N) \tag{3}$$

B. Real Exchange Rate

29. Let q^N denote the price of the home country's non-traded/traded good price ratio relative to that of the foreign country:

$$q^N = (p^N - p^T) - (p^{N*} - p^{T*}) = (\theta^T - \theta^{T*}) - (\theta^N - \theta^{N*}) \tag{4}$$

which depends only on the relative productivity differentials. To simplify, in what follows, the foreign country's productivities are assumed to be constant and their logarithm normalized to zero.

30. Let q^x denote the relative price of the home traded good:

$$q^x = p^T - (s + p^{T*}) \tag{5}$$

31. The CPI-based real exchange rate $q = p - (p^* + e)$ then captures both the nontraded/traded price ratio (relative to the foreign country) q^N, and the price of the home traded to the foreign traded good (q^x).

$$q = (1 - 2\alpha^T)q^x + \alpha^N q^N \tag{6}$$

where α^N, α^T are the shares of nontraded and imported goods in the CPI.

C. Internal Equilibrium

32. Internal equilibrium requires that the value of income equal the value of expenditure:

$$Y(\Theta^N,\Theta^T) = C(W,r,Y) + I(r) + G + TB(Y,q^x) \tag{7}$$

where W is wealth (foreign assets), r, is the real interest rate, Y is GDP, and $C_W > 0, C_r < 0, 0 < C_Y < 1; TB_q < 0, TB_Y < 0$

33. Real interest parity requires that

$$\dot{q} = r - r^* = r \tag{8}$$

34. Totally differentiating (7) and using (8) gives the schedule for internal equilibrium:

$$\dot{q} = \frac{1}{C_r + I_r}\left\{C_W(W-\bar{W}) + \frac{TB_q}{(1-2\alpha^T)}(q-\alpha^N q^N) + dG - (1-C_y - CA_y)dY(\Theta^N,\Theta^T)\right\} \tag{9}$$

35. The internal equilibrium is upward sloping in (q,w) space: a higher real exchange rate deteriorates the trade balance and reduces aggregate demand. This fall in aggregate demand requires higher consumption and therefore higher wealth.

D. External Equilibrium

36. External equilibrium states that foreign wealth is accumulated as long as there is a current account surplus:

$$\dot{W} = r^*(W-\bar{W}) + TB_y dY(\Theta^T,\Theta^N) + TB_q\left[\frac{(q-\alpha^N q^N)}{(1-2\alpha^T)}\right] \tag{10}$$

37. The external equilibrium is also upward sloping in (q,w) space: higher stock of foreign assets yields a greater net factor payments which finances a trade deficit (in turn associated with a more appreciated real exchange rate).

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